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STEAM TRAPS AND STRAINERS
by PROFESSOR F. C. LEA, D.Sc., M.Inst.C.E., M.I.Mech.E.
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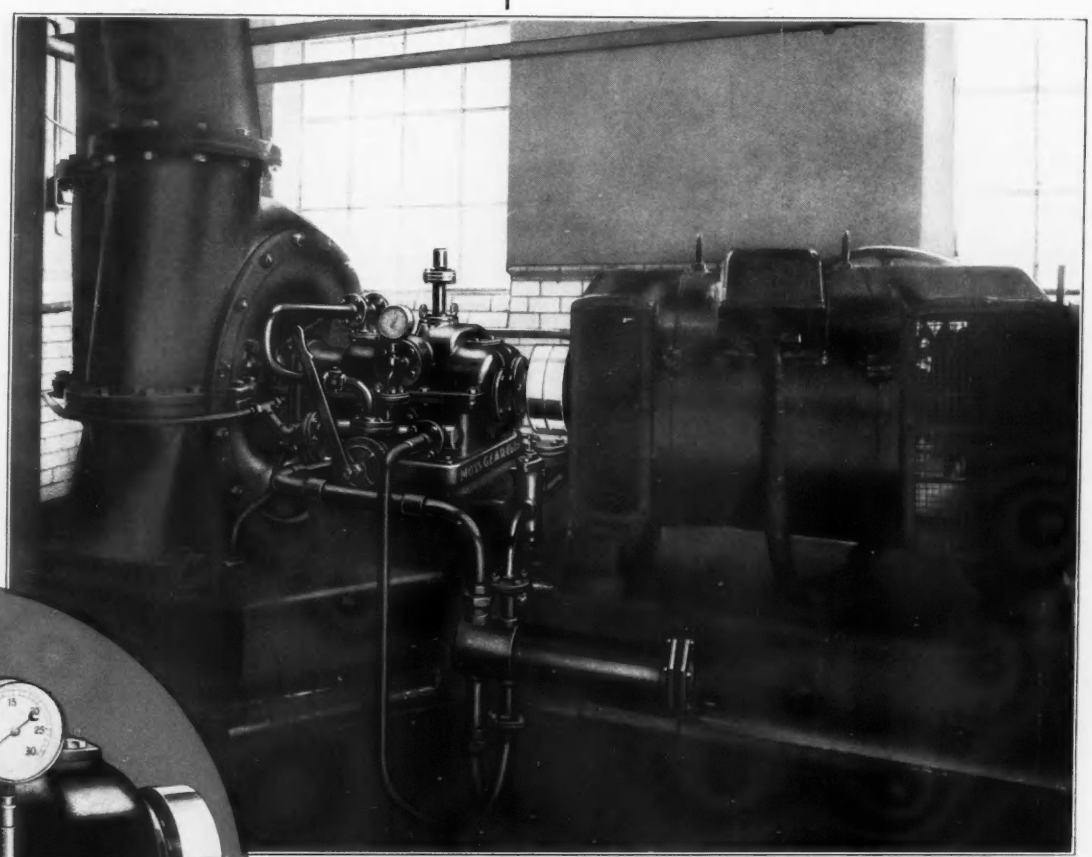

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A Seven-Day Journal

New G.W.R. Sleeper Creosoting Works.

On Tuesday, November 19th, the Great Western Railway Company announced the official opening of its new Sleeper Creosoting Works at Hayes, Middlesex. The works are designed to deal with half a million sleepers annually, and to enable the whole of the operations of impregnating and preparing the sleepers ready for the track to be carried out under cover. They are equipped with the latest time and labour-saving devices, electrically driven conveyors being used to bring the various materials together, to pass the sleepers along through the adzing and boring machines, and through the chairing machines, and finally out to the special wagons into which they are dropped ready for dispatch to various parts of the system. The adzing and boring machine is designed to deal with one sleeper every ten seconds, during which time the bolt holes are bored and the necessary grooves cut in the sleeper face to match those on the two chairs. From this machine the sleepers pass on a special train of trollies into a cylinder in which they are impregnated, or "pickled," with creosote under a pressure up to 200 lb. per square inch. The company claims that the two new cylinders provided for this purpose are the largest in the country, being 90ft. long with an inside diameter of just under 7ft. Each holds about 660 sleepers. Working tanks are provided to each cylinder, in addition to storage tanks, having a total capacity for about 65,000 gallons of creosote, and it is expected that, at full output, the consumption of creosote will be in the region of 1½ million gallons annually. From the cylinders the sleepers pass on to the chairing machine, where the chairs are not only bolted on to the sleepers, but set to gauge ready for laying in the line. Provision is also made at the new works, which cover an area of 19 acres, for a stacking yard to hold about 750,000 sleepers for seasoning.

The Late Mr. Theodore Stretton.

We regret to have to record the death at the age of fifty-nine of Mr. Theodore Stretton, an electrical engineer well known in South Wales. Educated at St. Edmund's College, London, the Regent-street Polytechnic, and in the Engineering Department of Cardiff University College, he eventually became managing director of the Concordia Electric Safety Lamp Company, Ltd. His early practical experience was gained in an engineering apprenticeship at Brown, Lenox and Co.'s works, Pontypridd. He afterwards became assistant engineer to Robert W. Blackwell and Co., Ltd., London, and subsequently engineer-in-charge at the Ringsend power station, Dublin. Later he was appointed engineer in the South Wales district and carried out a number of the earliest tramway and overhead transmission schemes. In 1905 he entered into partnership with Mr. Sidney B. Haslam, and was for many years joint managing director of Haslam and Stretton, Ltd., electrical and mechanical engineers. As an inventor Mr. Stretton was especially interested in the development and use of electric safety lamps for mines, and was the principal patentee of the Thor lamp. In 1925 he was made President of the Association of Mining Electrical Engineers, in the activities of which he had long taken an active and helpful interest. He was also a member of the Institutions of Electrical and Mechanical Engineers, and of the South Wales Institute of Engineers.

Motor Car Makers and the Steel Trade.

Recently complaints have been made by British motor car makers that they were paying about one-third more for their steel than foreign competitors, and that there was a "steel ring" against them in this country. These protests have been followed by the announcement that a company has been formed with a capital of £517,500 to acquire a site of between 50 and 60 acres at Alderley, near Wolverhampton, for the erection of a plant to manufacture the steel sheets required by the Austin Company. It is not known whether other motor car manufacturers besides the Austin Company are interested in this venture, and it is understood that it is not intended to manufacture raw steel. Some resentment is felt by the steel makers at the criticism of their price policy as well as by the expressed intention to set up a steel works. It is pointed out that in most of the lighter classes of cars less than 3 cwt. of sheets per car are used, and the price charged for these sheets varies from 16s. to 19s. per cwt., according to quality, so that the total cost of the sheets used in one car is less than £3. One British steel maker argues that whilst the cost of a cheap British car is now £40 to £60 higher than that for a car of corresponding quality in the United States, the cost of the sheets would have an insignificant influence upon the ultimate price. It is also denied that the price of steel sheets used in the manufacture of cars has been raised. Two or three years ago the quotation was £23, to-day it is £16 for medium and £20 for the highest quality, and only an expansion in the demand can enable these prices to be reduced. Carrying this argument to its logical conclusion, the steel makers are inclined to suggest that the motor car manufacturers, by a drastic cut in prices, might so increase the sale of their cars as to be able to take more steel and thus enable the steel makers to reduce prices.

The Normandie.

The large hall of the Institution of Electrical Engineers was more than filled on Friday last, November 15th, at a joint meeting of the Institution of Mechanical Engineers and the British Section of the Société des Ingénieurs Civils de France, when Monsieur Jean Marie, a director of the Compagnie Générale Transatlantique, presented a paper on "Technical Peculiarities of the Liner 'Normandie.'" The paper was read by Monsieur de Malglaive, resident director of the French Line in London, and was followed by an excellent film showing the construction of the liner and her propelling machinery. In its conception and execution the film was outstanding. With regard to the paper itself, the description given does not greatly add to the account of the construction of the "Normandie" and her propelling and auxiliary machinery which appeared in our issues of May 31st to June 21st. In conclusion, Monsieur Jean Marie said that vibration had appeared in the neighbourhood of the propellers, at certain speeds, but that plans had been drawn up and would be carried out during the winter which, it was believed, would be successful in suppressing the inconvenience. The paper was not discussed. The lecturer and reader were thanked by Colonel A. E. Davidson, who presided, and by Sir George Humphreys.

Names for 1935 Naval Ships.

We have already referred in these columns to the contracts for the various ships of the 1935 Naval Programme, which have recently been placed. On Wednesday, November 13th, it was officially announced by the Admiralty that the following names had been allotted to ships built under the 1935 new construction programme. The "Southampton" class cruiser, to be built by Fairfield, "Liverpool"; the Hawthorn-Leslie cruiser "Manchester"; and the Devonport cruiser "Gloucester." The "Porpoise" class submarine will be called "Cachalot," and the "T" class submarine "Triton," both being built by contract; while the "Swordfish" class submarine, to be built at Chatham, is to be named "Sterlet." The names of some of the remaining smaller ships are:—Sloop minesweepers: "Hazard" and "Hebe," by contract; "Sharpshooter," Devonport. Convoy sloop: "Bittern," by contract. Coastal sloops: "Sheldrake" and "Kittiwake," by contract. Surveying ship: "Gleaner," by contract. Boom Gate vessels: "Ebgate" and "Bargate," by contract. Coastal minelayers: "Vernon," by tender; "Plover," by contract. Magnetic survey vessel: "Research," by contract.

Modern Methods of Gliding and Soaring.

The lecture given by Herr Robert Kronfeld on "Modern Methods of Gliding and Soaring" at Monday's meeting of the Engineers' German Circle was of unusual technical interest, and the large hall of the Institution of Mechanical Engineers was well filled to hear it. Herr Kronfeld has achieved an international reputation on account of his remarkable experiments with gliders and ultra-light aeroplanes, and he described with the aid of excellent slides the methods of gliding and soaring training used in German gliding schools, both inland and on coastal sand dunes. He further discussed various methods he has developed of upwind soaring, both below and above cumulus clouds, and of soaring in front of advancing storm clouds. He dealt also with the possible use of ascending and descending thermal air currents. Herr Kronfeld showed how the study of gliding and soaring methods and the construction of light machines had already exercised an important influence on scientific aeroplane construction. He anticipated a further rapid extension of gliding technique, and expressed his personal pleasure in being in England to help in the formation of gliding clubs and schools, which are being fostered by the Royal Aeronautical Society and the British Gliding Society, and assisted by the Government.

Building Research.

The 1934 annual report of the Building Research Board, which was issued on Monday by the Department of Scientific and Industrial Research, and is published by the Stationery Office, states that the Board has placed its resources at the disposal of the Ministry of Health Committee to report on materials and methods of construction suitable for building working-class flats in connection with slum-clearance schemes. Further progress has been made, the report states, in research on problems of fire resistance and sound transmission, and the officers of the Board have closely co-operated in the design of a laboratory at Elstree for fire-resistance tests, which will be shortly opened by the Fire Offices Committee. An investigation into the vibration caused in buildings by traffic, machinery, pile-driving, &c., has been begun, and new measuring instruments have been designed. A model of a portion of London is being prepared for tests in a wind tunnel in order to determine the shielding effect of adjacent buildings as regards wind pressure. Various experiments have been conducted on heating and ventilation, and a new method for controlling humidity has been worked out. During the year under review over 2000 inquiries and special investigations have been dealt with, which shows an increase of nearly 25 per cent. over the total for the previous year. Among the new materials investigated are floor compositions consisting of rubber latex and cement, with fillers, which have stood up well to the tests made. Work has also been done on the weathering qualities of stones, and stone preservatives.

British Oil Prospecting Licences.

Thirty licences have been granted to the D'Arcy Exploration Company, the development company of the Anglo-Iranian Oil Company, to prospect in areas totalling 5438 square miles in Surrey, Sussex, Hampshire, Dorset, Wiltshire, Yorkshire, Lincolnshire, Nottinghamshire, Leicestershire, Rutland, Cambridgeshire, and Norfolk. The licences have been issued by the Board of Trade under the Petroleum (Production) Act, 1934, and the Petroleum (Production) Regulations, 1935. Particulars of the situation and boundaries of the areas were published in the *London Gazette*, and a map showing the areas for which licences have been issued can be inspected on application to the Petroleum Department, Mines Department, Dean Stanley-street, S.W.1. Applications for more than twenty licences for other areas have been received and are now under examination. The application fees for a prospecting licence are £20, plus a security deposit of £6 per square mile, with a minimum of £400. The Petroleum (Production) Act came into operation in June last. It covers the issue of prospecting licences for a period of three years, and also mining licences for a period of fifty years, which can be extended to seventy-five years. The application fees for a mining licence are £40 and the security deposit £20 per square mile with a minimum of £1000. The British Government has a holding of £7,500,000 in the £13,500,000 ordinary capital of the Anglo-Iranian Oil Company. In an official statement the company says that "after considering the scientific evidence collected by the geologists regarding the possibility of the existence in the United Kingdom of conditions favourable for the accumulation of petroleum, the company has decided that there is a sufficient case to justify investigation by test drilling, in addition to further geological and geophysical work."

An Unusual Goods Train Derailment.

The serious flooding in various parts of the country during the past week was responsible for an unusual accident on the Southern Railway Company's London-Southampton line on Monday, November 18th, when an empty milk train returning from London to Salisbury on the fast down track was derailed at Potbridge, three-quarters of a mile west of Winchfield Station. The accident occurred at a wide cutting, nearly 100ft. deep, which is spanned by a road bridge with high brick piers. Some time during the night a portion of the banking collapsed, leaving a cavity some 10ft. wide. The weight of the displaced mass of clay and sand forced up a section of the down line, and for nearly 200ft. the slow track was tilted to an angle of between 30 deg. and 45 deg. In places the rails were forced apart for from 10ft. to 15ft. The engine and part of the train had passed the spot when the derailment occurred. The locomotive ran off the track into the 6ft. way between the up and down lines. Fortunately, it did not overturn, and the crew escaped unhurt. The engine and sixteen wagons were derailed, and all four lines were blocked.

New Lee Valley Bridges.

On Saturday, November 16th, it was announced that the Middlesex County Council had approved of the construction of two new bridges to carry the Lee Valley-road and the Lee Valley-road diversion over the relief channel which will be built in connection with the new reservoir to be constructed by the Metropolitan Water Board in the Lee Valley. The approval was given to the Water Board's scheme, subject, in the case of the Lee Valley-road bridge, to provision being made for a road width of 45ft. on the understanding that the County Council reimbursed the Metropolitan Water Board for the extra cost involved. In asking for approval of the acquisition of the land, the Highways Committee had drawn attention to the works involved in connection with the construction of a new reservoir at Enfield, south of the existing "King George" reservoir. These works included a new channel from the existing overflow weir above Ponders End lock, to pass under the Lee Valley-road, and therefore entailing the construction of a new bridge. In addition, it was understood that the County Council intended to divert the Lee Valley-road at the western end and to carry it over the River Lee Navigation. Owing to local needs, it had been decided that while land on the east side of the Lee Navigation sufficient to make a future connection to the proposed new viaduct should be bought the Lee Valley-road should not be closed, but should remain as part of the local roads scheme.

Intensities of Flood Discharges.

By GEORGE BRANSBY WILLIAMS, M. Inst. C.E.

Provision for Floods in Engineering Works.

THE recent failure of the dam near Ovada in Piedmont must have aroused interest in the question of the maximum intensities of discharge in floods. It is a subject which has been often investigated, but as to which there is still much uncertainty. In deciding on the maximum rate of flood flow to be provided for by the spillway of a dam, in a drainage channel or under a bridge, engineers have been guided to some extent by the law of probabilities. In other words, they have trusted to luck, and the extent to which it has been considered legitimate to gamble has been determined by the nature and extent of the damage that would be suffered if the estimated rate of flow were exceeded. In some cases the estimates have proved too optimistic. There have been several examples of destruction of dams due to inadequate spillway capacity, one of the best known being the failure of the Johnstone dam in Pennsylvania. The Gleno dam in Italy was destroyed in the same way a few years ago, but in that case it was admitted that bad workmanship and the poor quality of the materials used contributed to the disaster, even if they were not the chief cause of it. There have been a number of instances of railway and road bridges, built with insufficient waterway, being swept away, and in some cases considerable interruption of traffic, and serious inconvenience and loss have resulted. It is clear that the possible maximum intensities of flood discharge have often been underestimated, and it may be supposed that a number of existing dams and bridges would be destroyed by floods less intense than some which have actually been experienced in many parts of the world.

From a practical point of view, the provision to be made for floods in any engineering structure must depend upon the nature of the work affected. In the case of a drainage channel, from which the water would overflow in a period of storm and cause only a temporary, and comparatively harmless, inundation of adjoining land, a conservative allowance would be made for storm water. On the other hand, a large dam, on which millions of pounds had been spent, and the failure of which would be a first-class disaster, would need to be made safe against a flood of any possible magnitude. Between these extremes there are many types of engineering works. For a main road the question of the loss and inconvenience that would result from its temporary inundation would affect the waterway to be provided in the bridges and culverts. It would be necessary to ensure the safety of an important railway bridge at least for the economic life of the structure.

Possibility and Probability of Abnormal Rainstorms.

The possibility of a downpour of rain occurring sufficiently abnormal to produce a disastrous flood exists in most places, but the probability of its taking place is much greater in some parts of the world than others. To take an extreme example, the mean annual rainfall on parts of the Western Ghats in India is between 300in. and 400in. per annum, and is precipitated throughout the wet season at an average rate of between 2in. and 3in. a day. It would be absurd to suggest that the provision for a flood discharge required in that region would also be suitable for places in Sind, where the mean annual rainfall is only 2½in. Or, as another illustration, in Calcutta, in 1912, more than an inch of rain fell in an hour on nineteen separate occasions; on one of these 3in. fell in 20 minutes, or at the rate of 9in. per hour. No engineer designing a drainage system for Manchester, for example, would make provision for storm water at the same rate of off-flow as in Calcutta, although rainfall intensities comparable with that just mentioned have been experienced in English towns. There was an instance in Canterbury in 1875 when rain fell for 20 min. at a rate of nearly 6½in. an hour. On the other hand, within wide limits, it cannot be found that the recorded maximum intensity of rainfall bears a definite relationship anywhere to the mean annual rainfall. At the three cities—Patna, Calcutta, and Rangoon—the mean rainfalls are 42in., 62in., and 99in. respectively, but the maximum intensities hitherto recorded at these three places are in the inverse order to their means. Attempts, such as have been occasionally made, to base a formula for flood discharges on the mean rainfall must clearly be a failure.

Ratio of Probable Intensity of Discharge to Probable Interval Between Occurrence of Flood.

In devising any formulæ for flood flow consideration much be paid to the relationship between the intensity of a flood and the period that would probably elapse before its recurrence. A good deal of investigation has taken place on this point, chiefly in the United States. One of the best-known formulæ for the time-intensity relationship is that devised by W. E. Fuller, as a result of his observations on streams in the Eastern U.S.A.

This is

$$Q_{max} = Q_1 (I + 0{\cdot}8 \log. T),$$

where T is the period in years, Q_{max} the maximum rate of flood discharge during that period, and Q_1 the maximum flood rate that may be expected to recur at intervals of one year. The following table shows the relative magnitude of the floods that may be expected to recur at the respective intervals, according to this formula:—

Table I.—*Relationship Between Probable Frequency of Floods and their Probable Maximum Intensity, According to W. E. Fuller's Formula.*

1 Intervals between recurrence of floods in Col. 2 in years.	2 Comparative maximum intensities of floods.
1	1·00
2	1·24
3	1·38
5	1·56
10	1·80
20	2·04
50	2·36
100	2·60
200	2·84
500	3·16
1,000	3·40
1,500	3·54
2,000	3·64
5,000	3·96
10,000	4·20
100,000	5·00
500,000	5·56
1,000,000	6·30

It is to be deduced from Mr. Fuller's formula that a flood 1½ times the one-year flood will probably occur at intervals of four years, and a flood twice the one-year flood at intervals of twenty years. The flood expected to recur once in one hundred years is 2·6 times the one-year flood and 1·3 times the twenty-year flood. The interval of time between floods of twice the intensity of the one hundred-year flood becomes 178,000 years. These calculations are interesting, but experience shows that such theories are liable to be upset by actual facts. A noticeable feature of most long series of flood records is that a flood occasionally takes place that far exceeds in intensity any others. It is such floods that are responsible for disastrous failures of dams and bridges, and it is precisely in regard to them that there is most uncertainty.

Records of Abnormal Floods.

It may be assumed that on every catchment there is some rate of discharge which cannot be exceeded, but what that rate is has not been decided. If Mr. Fuller's formula were to be accepted as mathematically correct, the theoretical maximum discharge rate would go on increasing with the interval of time assumed, *ad infinitum*, although it will be agreed that rates of flood flow that are not reached until astronomical periods of time have elapsed hardly need to be taken into serious consideration. As some guidance in this matter, the discharge rates of certain abnormal floods that have occurred in various countries are set forth in the following table:

Table II.—*List of Some Abnormal Floods that have Occurred in Various Parts of the World.*

Place.	Area of catchment in square miles.	Date of flood.	Rate of off-flow in cusecs per square mile.
Bulls Run, Long Level, Pennsylvania	0·58	July, 1914	4170
Docker's Hollow, North Braddock, Pennsylvania	0·60	July, 1917	4000
Manoa, West Branch, Oahu, Hawaii	1·00	Jan., 1920	3250
Redaven, Devon, England	1·56	1917	2525
Honey Creek, East Fork, New Carlisle, Ohio	6·70	July, 1918	2210
Wailua, near Lihue, Kanai, Hawaii	23	Jan., 1921	1955
Elkhorn Creek, Keystone, West Virginia	44	June, 1901	1363
Salado Creek, Salado, Texas	148	Sept., 1921	966
Musi River, Hyderabad, India	862	—	493
Damoda River, Bengal, India	7211	Aug., 1913	90
Sone River, Bihar, India	26,000	Aug., 1923	47
River Amazon at Obidos	1,945,000	—	3·5

These figures do not lead to any very definite conclusions nor can it be stated that the rates of discharge recorded represent the highest intensity of flood flow possible on the catchments on which they occurred. It may, however, be supposed that greater rates of discharge are improbable. It appears that run-offs at the rate of over 4000 cusecs per square mile have been experienced on small catchments, but it seems unlikely that an off-flow of 5000 cusecs per square mile would occur anywhere. The largest actual flood volume of which there is any record is that on the Amazon, when the peak flow was over 6,800,000 cubic feet a second.

Classification of Floods.

From an engineering point of view a convenient classification of floods is into four categories: (*a*) "frequent," which may be taken to be floods which will probably recur at intervals of from three to five years; (*b*) "unusual," being floods which may be expected to recur at intervals of about twenty years; (*c*) "probable maximum," which are likely to recur not more often than once in 100 years; and (*d*) "abnormal" floods, caused by cloudbursts or other extraordinary meteorological phenomena. The most practical method of dealing with the problem is to estimate as nearly as possible the rates of flow in "probable maximum" floods on average catchments and multiply these rates by some factor of safety to provide for abnormal floods. The factor of safety would vary with the nature of the catchment, the class of the structure that would be affected by the flood, and other local circumstances. This system is much the same as that adopted by the Committee of the Institution of Civil Engineers on "Floods in Relation to Reservoir Practice" in their interim report. From an examination of records of actual floods on uplands catchments in the British Isles the Committee proposed a curve for normal maximum floods on such catchments, and considered that the peak rates of, what they styled, "acute catastrophic floods" might be at least twice those of the normal maximum floods. This ratio may be accepted as a general guidance in other countries and it may also be assumed that on any catchment floods of type (*a*) will probably be half the intensity, and type (*b*) four-fifths of the intensity of type (*c*).

Factors Affecting Rates of Flood Discharge.

The rate of discharge from a catchment in any storm depends on a number of factors, most of which vary from one catchment to another and some of which vary from time to time on the same catchment. The most important of these are: (*a*) the area of the catchment; (*b*) its shape; (*c*) the slope of the ground; (*d*) the geological formation of the basin; (*e*) the nature and condition of the surface and of the vegetation on it; (*f*) the number and character of the drainage channels; (*g*) the climate; (*h*) the period of the year in which the storm takes place; and (*k*) the duration, distribution, and intensity of the rainstorm. At first sight it would seem a hopeless task to reduce an event affected by such a complication of circumstances to a mathematical formula that could have any sort of general application. It is certainly true that the most reliable method of estimating the maximum probable flood discharge on any particular catchment is to ascertain the period of concentration at the outfall either by actual observations or from a contoured plan; then to adopt figures for the maximum intensity of rainfall probable during that period, and for the percentage of the rainfall flowing at the outfall at the end of the period of concentration. This may be assumed to be the peak rate of discharge in the flood.

Formulæ for Rates of Flood Flow.

Nevertheless a careful study of a large number of records of floods shows that there has been, what can only be considered in the circumstances, remarkable consistency between the maximum rates of flow in floods that have occurred from catchments where the climatic and other conditions are more or less similar and which are not abnormally precipitous or abnormally flat, and that empirical formulæ can be devised that can be widely applied and will be sufficiently reliable, at all events for preliminary computations of flood discharge rates. This appears to have been the general experience of investigators into the subject, for a number of such formulæ have been proposed. These have taken two forms: (*a*) formulæ in which factors have been introduced to allow for topographical features of the catchment; and (*b*) formulæ in which the flood flow is correlated only to the area of the catchment. The latter usually take the form

$$Q = C A^n,$$

Q being the rate of the maximum flood flow off the catchment in cusecs, A the area of the catchment in square miles, C a constant and n an index less than unity. It is more convenient for purposes of comparison to get a result in cusecs per square mile; to do so it is necessary to divide the right-hand expression by the area of the catchment A and the formula becomes

$$Q = \frac{C A^n}{A} = \frac{C}{A^{1-n}} = \frac{C}{A^m}$$

where Q = rate of off-flow in cusecs per square mile and m is a fraction $= 1 - n$.

A study of a large number of flood records in various parts of the world shows that in all cases exponential curves of this character can be found which agree with these records. The method adopted has been to tabulate the intensities of the floods recorded and to arrive at empirical equations conforming to the data collected. This has been obtained for the British Isles, India, and the United States. The records of floods in these countries are fairly

comprehensive. The present investigation is based on more than 1200 of them. As to their accuracy, it is not possible to judge, but nearly all have been compiled by responsible authorities. The estimates of the rate of flow have usually been arrived at from the cross sections and surface gradients of the rivers and streams during the floods. Such estimates are more likely to err on the high side than the low. It seems not unreasonable to suppose that results arrived at in countries covering, between them, an area of 5,000,000 square miles, extending over a difference of latitude of 50 deg., possessing climates varying from intensely cold to intensely hot, and including practically rainless deserts and the wettest areas known, are of wider application. It has been ascertained that 89 of the "Transactions" of the American Society of Civil Engineers in connection with a paper by C. S. Jarvis. The earliest of these date from 1843, and the list probably includes most of the large floods that have taken place in that country during the last half-century. For the purpose of this investigation the following areas have been dealt with separately: (*a*) N.E. States, (*b*) Mississippi Valley, (*c*) Rocky Mountains, and (*d*) Pacific Coast States.

N.E. States.

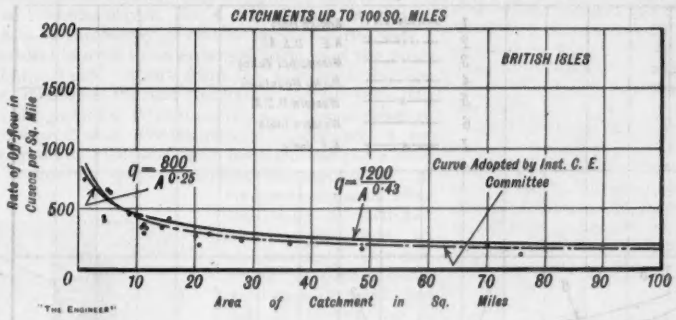
These states receive a moderate rainfall evenly distributed throughout the year. Near the coast the mean is between 40in. and 45in. per annum, and further inland between 35in. and 40in. The average wettest month is usually about 130 per cent. of the average monthly rainfall for the whole year, and the average driest month between 75 and 80 per cent. of this average. A number of the recorded floods are shown on diagrams Figs. 2A, 2B, and 2C. The curves of probable maximum flood intensities are also shown. The equations of the latter are:

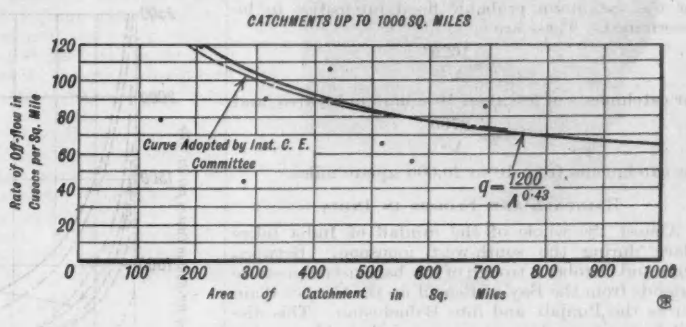
$$q = \frac{1480}{A^{\cdot 25}}$$

for catchments of less than 10 square miles, and

$$q = \frac{2400}{A^{\cdot 48}}$$

for catchments 10 to 20,000 square miles.


CATCHMENTS UP TO 100 SQ. MILES
BRITISH ISLES
Rate of Off-flow in Cusecs per Sq. Mile
q = 800 / A^0·25
q = 1200 / A^0·43
Curve Adopted by Inst. C. E. Committee
Area of Catchment in Sq. Miles
"The Engineer"


CATCHMENTS UP TO 1000 SQ. MILES
Rate of Off-flow in Cusecs per Sq. Mile
Curve Adopted by Inst. C. E. Committee
q = 1200 / A^0·43
Area of Catchment in Sq. Miles

FIGS. 1A AND 1B—FLOOD RECORDS FOR UPLANDS CATCHMENTS IN THE BRITISH ISLES

a curve with an equation of the form given above, with constant values for C and *m*, is suitable for all catchments in the same district except very small and very large ones. For both of these the values used for the intermediate catchments give results that are too high. The method found to give the closest agreement with the records has been to adopt one set of values for C and *m* for areas from 10 square miles to 20,000 square miles and another for areas below 10 square miles. No formula has been arrived at for catchments of more than 20,000 square miles, for the number of records of flood flows on such hitherto obtained is insufficient for general deductions.

Floods in the British Isles.

In the report of the Committee of the Institution of Civil Engineers, already referred to, flood records

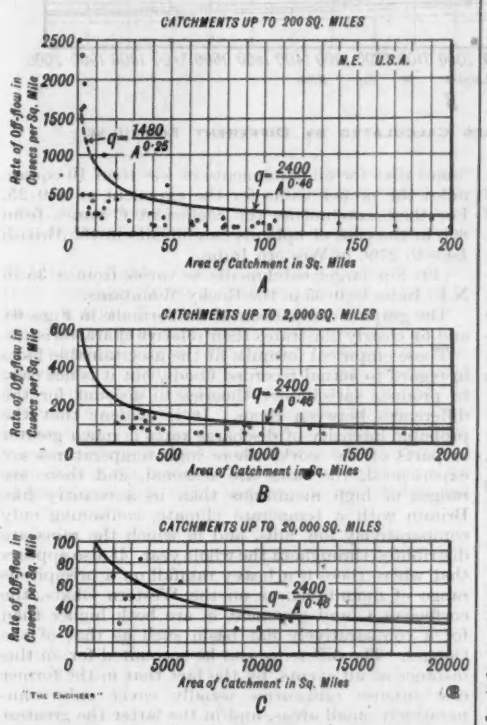

CATCHMENTS UP TO 200 SQ. MILES
N.E. U.S.A.
Rate of Off-flow in Cusecs per Sq. Mile
q = 1480 / A^0·25
q = 2400 / A^0·48
Area of Catchment in Sq. Miles
A
CATCHMENTS UP TO 2,000 SQ. MILES
q = 2400 / A^0·48
B
CATCHMENTS UP TO 20,000 SQ. MILES
q = 2400 / A^0·48
C
"The Engineer"

FIG. 2—FLOOD RECORDS IN NORTH-EASTERN U.S.A.

for a number of uplands catchments in the British Isles were tabulated. These are shown on the two diagrams, Figs. 1A and 1B. The equations for the curves representing the probable maximum flood intensities on these catchments are:

$$q = \frac{800}{A^{\cdot 55}}$$

for areas of less than 10 square miles, and

$$q = \frac{1200}{A^{\cdot 43}}$$

for areas over 10 square miles.

The curve adopted by the Committee of the Institution of Civil Engineers is shown on the diagram. It will be observed that it shows somewhat lower values for *q* than the formula.

Floods in the United States.

The most complete list of records of floods in the United States seems to be that to be found in Volume

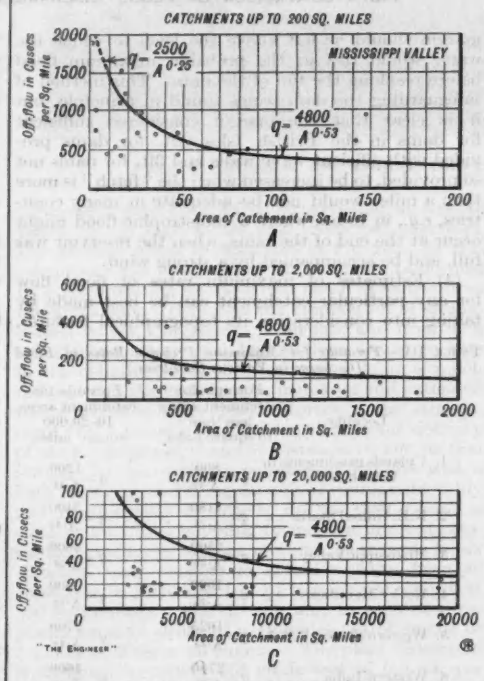

CATCHMENTS UP TO 200 SQ. MILES
MISSISSIPPI VALLEY
Off-flow in Cusecs per Sq. Mile
q = 2500 / A^0·25
q = 4800 / A^0·53
Area of Catchment in Sq. Miles
A
CATCHMENTS UP TO 2,000 SQ. MILES
q = 4800 / A^0·53
B
CATCHMENTS UP TO 20,000 SQ. MILES
q = 4800 / A^0·53
C
"The Engineer"

FIG. 3—FLOOD RECORDS IN MISSISSIPPI VALLEY

Mississippi Valley.

The basin of the Mississippi covers an area of about 1¼ million square miles. Its floor rises comparatively gently towards the east, to the foot of the Appalachian Mountains (highest point 6700ft. above sea level), and more rapidly to the west as far as the foothills of the Central Range, where the surface level is about 6000ft. above the sea. The western watershed ridge reaches an elevation of between 14,000ft. and 15,000ft. There is considerable seasonal variation in the meteorological conditions of this part of the U.S.A. In the middle of the winter there is an area of high barometrical pressure to the west of the valley and a low pressure area on the south-west. At this period of the year the winds in the southern portion of the valley are towards the Gulf of Mexico, but by April conditions become reversed and the prevailing winds are from the Gulf until towards the end of the year. Throughout the whole region the rainfall is heavier in the summer than the winter, and the difference becomes more marked towards the south-west. In parts of Texas, at the extremity of the basin, the average rainfall in January is only 35 per cent. of the monthly average throughout the year, whilst that of May is 215 per cent. The recorded floods and curves of probable maximum flood intensities are shown on Figs. 3A, 3B, and 3C. The equations for the curves are:

$$q = \frac{2500}{A^{\cdot 25}}$$

for areas below 10 square miles, and

$$q = \frac{4800}{A^{\cdot 53}}$$

for areas of 10 square miles to 20,000 square miles. It will be observed that several records exceed the probable intensities by 100 per cent. or more. These floods come into the category of "catastrophic" floods, and no formula for probable maximum floods could be made to include them. Without local knowledge it is impossible to express any opinion as to whether there are any special conditions favouring excessive flood intensities in the places where they occurred. It may be noted that disastrous floods appear to have occurred more frequently on the Mississippi River than on most of the other great rivers of the world.

Rocky Mountains.

In mid-winter the Rocky Mountains are the centre of an area of barometric high pressure. By April this has been replaced by a trough of low pressure which remains more or less stationary until October. These mountains are to a great extent out of range of moisture-laden breezes from the Pacific or the Gulf of Mexico, and consequently, in spite of their great height, receive a scanty rainfall. Only on a very small area does the mean reach 30in. In many parts it is less than 10in. Nevertheless, as will be seen from Figs. 4A, 4B, and 4C a number of floods of high intensity have been recorded. The maximum flood intensity curves have the equations

$$q = \frac{1900}{A^{\cdot 25}}$$

and

$$q = \frac{3600}{A^{\cdot 55}}$$

for catchment areas below and above 10 square miles respectively.

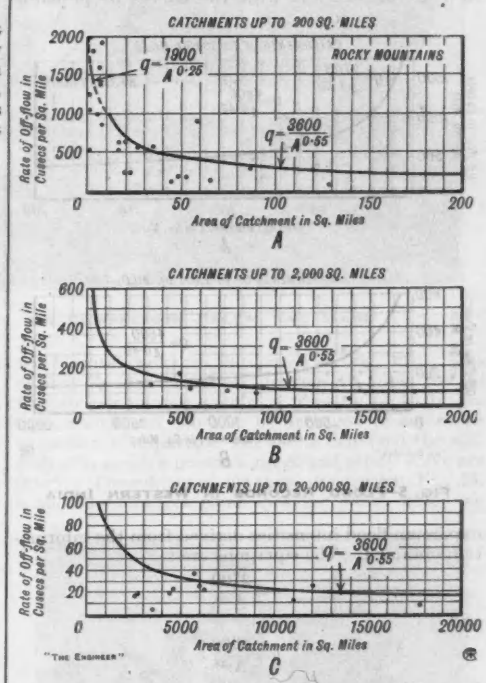

CATCHMENTS UP TO 200 SQ. MILES
ROCKY MOUNTAINS
Rate of Off-flow in Cusecs per Sq. Mile
q = 1900 / A^0·25
q = 3600 / A^0·55
Area of Catchment in Sq. Miles
A
CATCHMENTS UP TO 2,000 SQ. MILES
q = 3600 / A^0·55
B
CATCHMENTS UP TO 20,000 SQ. MILES
q = 3600 / A^0·55
C
"The Engineer"

FIG. 4—FLOOD RECORDS IN ROCKY MOUNTAINS

Pacific Coast.

The climate in the Western States varies considerably. In the winter the mean temperature in the

north of Washington State on the sea coast is about 40 deg. Fah., whereas inland a minimum of 35 deg. Fah. below zero has been registered. The mean January temperature in Southern California is 55 deg. Fah. In July the mean temperature in portions of the latter state is over 90 deg. Fah. The prevailing winds on the coast are from the west for most of the year. In Los Angeles the months between May and October are practically rainless, and 75 per cent. of the whole year's fall takes place in the four months December–March. The rainfall on parts of the coast range in Oregon and Washington is very heavy, the mean annual fall being over 100in. in places. The records of floods in these states are not so numerous as in some other parts of the U.S.A They are, however, sufficient to enable suitable curves for the maximum probable flood intensities to be determined. These are :

$$q=\frac{1625}{A^{\cdot 25}}$$

for catchments of less than 10 square miles area, and

$$q=\frac{2700}{A^{\cdot 47}}$$

for catchments from 10 to 20,000 square miles.

Rainfall and Floods in India.

Almost the whole of the rainfall of India takes place during the south-west monsoon. Between June and October a trough of low barometric pressure extends from the Bay of Bengal up the Ganges Plain across the Punjab and into Baluchistan. This distribution causes strong westerly winds to blow across the Arabian Sea and south-westerly winds to prevail in the Bay of Bengal. These winds carrying the moisture from the sea impinge against the long escarpment of the Western Ghats and the Khasi Hills in Assam, producing in both places rainfall of greater intensity than in any other part of the world. On the Western Ghats the belt of intense rainfall is a narrow one. The 200in. isohyet surrounds the summits of a range of mountains several hundred miles long, but on the lee side of this range the annual rainfall rate diminishes so rapidly that in some places within 60 miles of the coast it is less than 30in. Records of floods in this region have been maintained by the Bombay Irrigation Department, and a list of these is to be found in a study of run-offs and floods in the Bombay Presidency by C. C. Inglis and A. J. De Souza, published as a technical paper by the Bombay Government in 1930. A number of them are shown on Figs. 5A and 5B, with the curves of probable

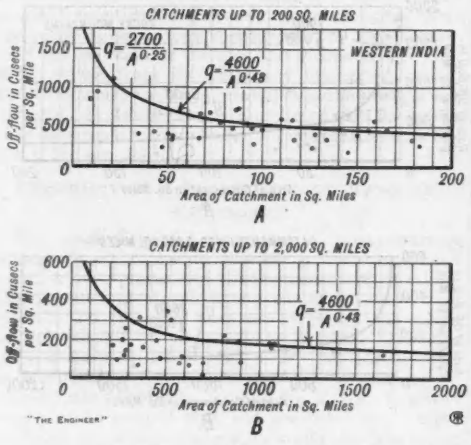


FIG. 5—FLOOD RECORDS IN WESTERN INDIA

maximum flood intensities derived from the information obtained. The equations are :

$$q=\frac{2700}{A^{\cdot 25}}$$

and

$$q=\frac{4600}{A^{\cdot 48}}$$

for catchments below and above 10 square miles respectively.

Floods in North-East India.

The information in regard to floods in the rest of India is not so complete as for the Bombay Presidency, but a good deal is available in the technical paper referred to above and also in papers read before the Institution of Civil Engineers by Sir Gordon Hearn, Messrs. G. L. Lillie, and E. L. Glass, before the Institution of Engineers (India) by Mr. W. A. Buyers, and in the discussions on these papers. It has been found that suitable curves can be obtained for flood intensities in North-East India, with equations

$$q=\frac{1400}{A^{\cdot 25}}$$

and

$$q=\frac{1700}{A^{\cdot 35}}$$

Conclusion.

The conclusions led to by the lines of investigation described may be summarised as follows.

(1) From an engineering point of view, the most suitable classification of floods is in four categories :—(*a*) "Frequent," (*b*) "unusual," (*c*) "probable maximum," and (*d*) "catastrophic," the last term being borrowed from the interim report of the Committee of the Institution of Civil Engineers on "Floods in Relation to Reservoir Practice."

(2) The ratios of intensities of the first three classes may be taken as (*a*) 0·50, (*b*) 0·80, (*c*) 1·00.

(3) For class (*d*) "catastrophic" floods, provision may be made by multiplying class (*c*) by a factor of safety that may vary from 1½ to 2½ according to circumstances. For the spillway of an earthen dam, the Committee referred to proposed that a certain margin should be left above the level to which the water would rise in the probable maximum flood before reaching the top of the dam. This method of safeguarding the dam seems sound in principle, but it is clear that the margin considered sufficient for dams in the British Isles (2ft. for dams provided with efficient wave walls and 3ft. for dams not so provided, to be increased when the "fetch" is more than a mile) would not be adequate in many countries, *e.g.*, in India, where a catastrophic flood might occur at the end of the rains, when the reservoir was full, and be accompanied by a strong wind.

(4) Estimates of maximum rates of flood flow for any particular catchment can be best made by taking into consideration its topographical features,

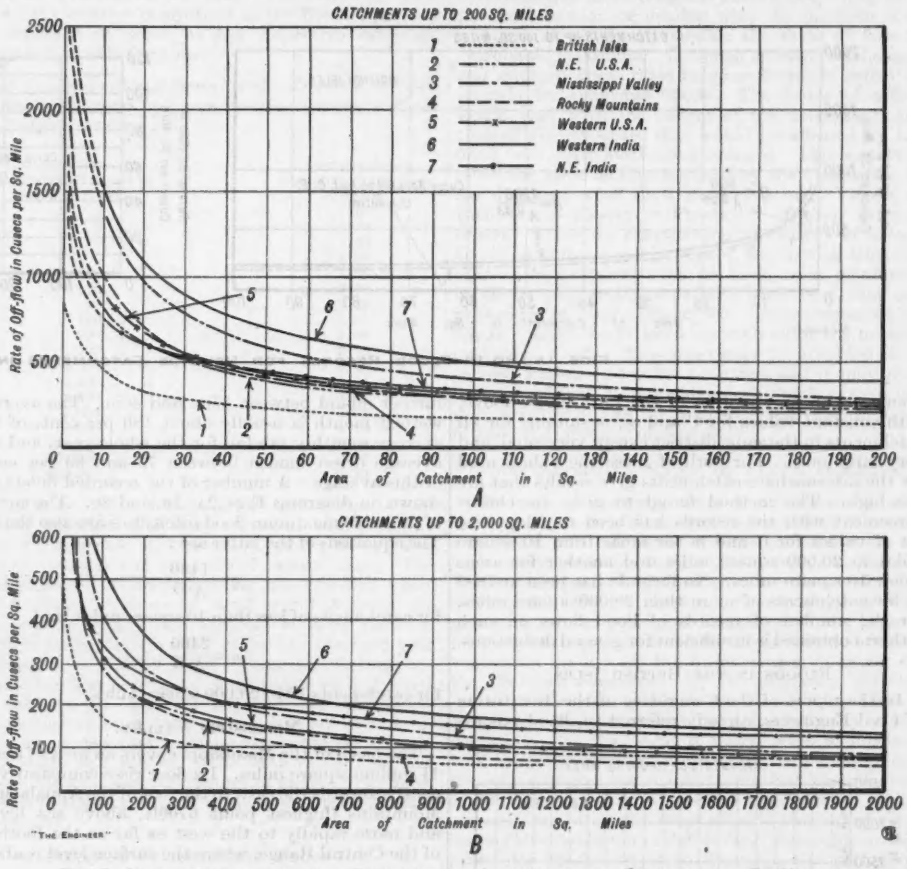


FIG. 6—COMPARISON OF FLOOD DISCHARGES CALCULATED BY DIFFERENT FORMULAE

TABLE III.—*Formulæ for Maximum Probable Rates of Flood Discharge in Various Countries.*

Locality.	Formula for catchment areas less than 10 square miles.	Formula for catchment areas 10–20,000 square miles.
1. Uplands catchments in British Isles	$q=\frac{800}{A^{\cdot 25}}$	$q=\frac{1200}{A^{\cdot 45}}$
2. N.E. United States	$q=\frac{1480}{A^{\cdot 25}}$	$q=\frac{2400}{A^{\cdot 46}}$
3. Mississippi Valley	$q=\frac{2500}{A^{\cdot 25}}$	$q=\frac{4800}{A^{\cdot 55}}$
4. Rocky Mountains	$q=\frac{1900}{A^{\cdot 25}}$	$q=\frac{3600}{A^{\cdot 55}}$
5. Western States, U.S.A.	$q=\frac{1625}{A^{\cdot 25}}$	$q=\frac{2700}{A^{\cdot 48}}$
6. Western India	$q=\frac{2700}{A^{\cdot 25}}$	$q=\frac{4600}{A^{\cdot 48}}$
7. N.E. India	$q=\frac{1400}{A^{\cdot 25}}$	$q=\frac{1700}{A^{\cdot 35}}$

period of concentration and probable maximum intensity of rainfall during that period.

(5) General formulæ for rates of probable maximum flood discharge can be arrived at applicable to extensive areas which will give comparatively reliable results for catchments not abnormally precipitous or very flat.

(6) These formulæ are of the form

$$q=\frac{C}{A^m}$$

where q is the rate of off-flow in cusecs per square mile, A the area of the catchment in square miles, and C and m constants.

(7) Values of C and m differ from one part of the world to another, but are the same for extensive areas in a country where climatic and other local conditions are more or less similar for all catchment areas except very large and small ones.

(8) It is found that the same values of C and m can be adopted in any locality for catchment areas from 10 to 20,000 square miles or more. Relatively smaller values of C and m are necessary for catchments of less than 10 square miles, and larger ones for very large catchments. Values suitable for the latter have not been determined.

(9) Table III gives the formulæ arrived at for various portions of the countries investigated. It is found that for all catchments of less than 10 square miles the proper value for the exponent m is 0·25. For these catchments the coefficient C varies from 800 in the case of uplands catchments in the British Isles to 2700 in Western India.

(10) For larger catchments m varies from 0·35 in N.E. India to 0·55 in the Rocky Mountains.

The graphic comparison of the formulæ in Figs. 6A and 6B clearly illustrates their relative characteristics.

These empirical formulæ fit the ascertainable facts in regard to actual recorded floods, but it is not easy to produce satisfactory theories to account for the differences between them. It is evident that the probable intensity of discharge rates is much greater in parts of the world where high temperatures are experienced, the rains are seasonal, and there are ranges of high mountains than in a country like Britain with a temperate climate, containing only comparatively low hills, and in which the rains are distributed throughout the whole year. It also appears that where there is a heavy rainfall on a precipitous range of mountains, as on the Western Ghats, the coefficient C and exponent m are both higher than for a comparatively flat basin such as that of the Ganges. The difference can be accounted for, in this instance at all events, by the fact that in the former case intense rainstorms usually cover only comparatively small areas, and in the latter the greatest floods are caused by deep cyclonic disturbances, producing very heavy rain over large stretches of country for several successive days.

The subject requires further investigation, but in the meantime it may be supposed that in parts of the world where conditions are similar to those in the countries included in this investigation, the curves of probable maximum rainfall will resemble those in the latter. For instance, it is probable that in Western France they will not differ much from the curves for the British Isles, and that the maximum flood rates in the basin of the Amazon will be found to be similar to, but somewhat greater than, those in the Mississippi Valley.

THERE is no physical connection between the terminus of the tramway at the end of Gray's Inn-road and that in Farringdon-road. Under the London Passenger Transport Board's proposals for next Session is one for linking up the two routes by means of trollybuses.

The Public Works, Roads, and Transport Exhibition.

No. II.

(*Continued from page 509, November 15th.*)

Siemens Electric Lamps and Supplies, Ltd.

"Sieray" electric discharge lamps, including the "Sieray-dual" lamp, shown in Fig. 18, which operates without a choke or condenser, are exhibited by Siemens Electric Lamps and Supplies, Ltd., of 38–39, Upper Thames-street, E.C.4. The lamp illustrated consists of the Sieray discharge lamp in series with a tungsten filament in an enlarged portion of the outer discharge bulb. Apart from the fact that the filament stabilises the arc discharge and obviates the need for a choke, it also serves as a supplementary light source with a considerable percentage of red rays, and the resultant light from the complete lamp has a pleasing colour. Undue overloading of the tungsten filament when the lamp is switched on is prevented by an auxiliary filament, which is subsequently automatically switched out of circuit by a thermal cut-out. As the discharge arc is stabilised by the resistance of the main tungsten filament and not by a choke, the use of a condenser is unnecessary, the power factor being approximately 0·95. Immediately the lamp is switched on a considerable amount of light is produced by the filament, and after about ten minutes the full luminous output is given by the filament and discharge combined. The filament consumes about 200 watts and the discharge tube 300 watts, which, like the filament, operates at normal efficiency. Most of the light is provided by the latter, and as the light from the filament is rich in red rays, it serves the dual purpose of improving the colour of the total light output and of increasing the lumens. The total light emitted is about equivalent to that obtained from a 750-watt tungsten filament lamp, or 60 to 70 per cent. more than that given by a 500-watt lamp of that type.

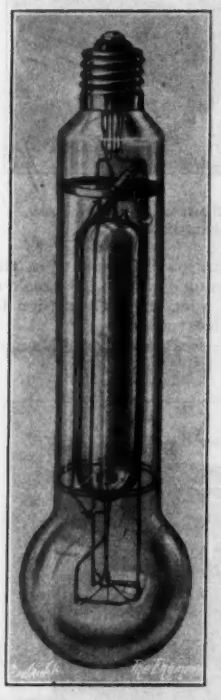


FIG. 18—"SIERAY-DUAL" LAMP—SIEMENS

The ordinary form of "Sieray" hot cathode electric discharge lamp is made in two types, designated "W" and "H," designed to operate on 200 to 260-volt A.C. supplies. The principal feature of the former lamp is the quality of the light emitted, which is said to show a marked improvement as compared with that of the ordinary high-pressure mercury type of discharge lamp. This improved colour is obtained by the addition of certain metals to the mercury contained in the tube. The proportions and vapour pressures of these metals are arranged to make their colours complementary to those emitted by mercury vapour, and the resultant quality of the light is greatly improved. The lamp is made in one size only rated at 400 watts. When colour rendering is not important the "H" type of lamp may be used. This lamp is made in two sizes, consuming 250 and 400 watts, both having a high efficiency.

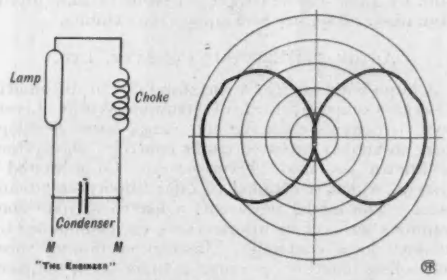


FIG. 19—DIAGRAM OF CONNECTIONS AND POLAR CURVE—SIEMENS

All the standard types of "Sieray" lamps are constructed on similar lines. The lamp is of tubular form and is fitted with a standard Goliath Edison screw cap. An outer glass jacket encloses an inner tube, and the space between the two minimises the loss of heat. The inner tube is composed of a special heat-resisting glass, and carries at each end an electrode consisting of a coil of thick tungsten wire surrounding a core of electron emitting material, one coil being connected to each terminal of the lamp cap. Auxiliary electrodes set up a preliminary discharge, which induces the main discharge to strike between the two main electrodes, and as soon as the main discharge occurs its lower resistance cuts out the auxiliary electrodes.

With all types of "Sieray" lamps, with the exception of the "Sieray-dual" lamp, a choke and condenser are employed and power factors from 0·85 to 0·90 are obtained. Adjustments of the choke coil to comply with a charge from, say, a 250-watt to a 400-watt lamp can easily be made. A diagram of connections and a characteristic polar curve showing the light distribution from a "Sieray" lamp are given in Fig. 19.

Broom and Wade, Ltd.

Included among the exhibits of Broom and Wade, Ltd., of High Wycombe, there is a range of air compressors, amongst which the portable sleeve valve compressor plants should be of particular interest to public works contractors and municipal engineers. One of these plants is illustrated in Fig. 20. In this compressor the functions of the valve are performed by a reciprocating sleeve driven by an excentric from the crankshaft. Owing to the elimination of spring-loaded valves, the passage of air into and from each cylinder is unobstructed, and as there are no pockets in the cylinder head, the clearance volume is much reduced and the cooling area increased and extended to the whole cylinder head. Moreover, the arrangement of the sleeve is said to be such that the delivery of air is continued when the piston is on the suction stroke. In the result the compressor operates with a high efficiency, and being capable of running smoothly and continuously at speeds up to 1200 r.p.m. is suitable for direct coupling to modern internal combustion engines or electric motors. It is made in six standard sizes, ranging in actual capacity from 80 cubic feet to 340 cubic feet of free air per minute at 100 lb. pressure. The driving unit in each of these plants consists either of a Hercules petrol engine or a Lister or Ruston oil engine. The plant illustrated is designed to deliver 255 cubic feet of free air per minute at 100 lb. pressure and is driven by a Ruston oil engine which develops 70 b.h.p. at 1000 r.p.m. The engine is started by compressed air and a hand starting gear for emergency use is included in the equipment. The whole plant has a weight of 9968 lb.

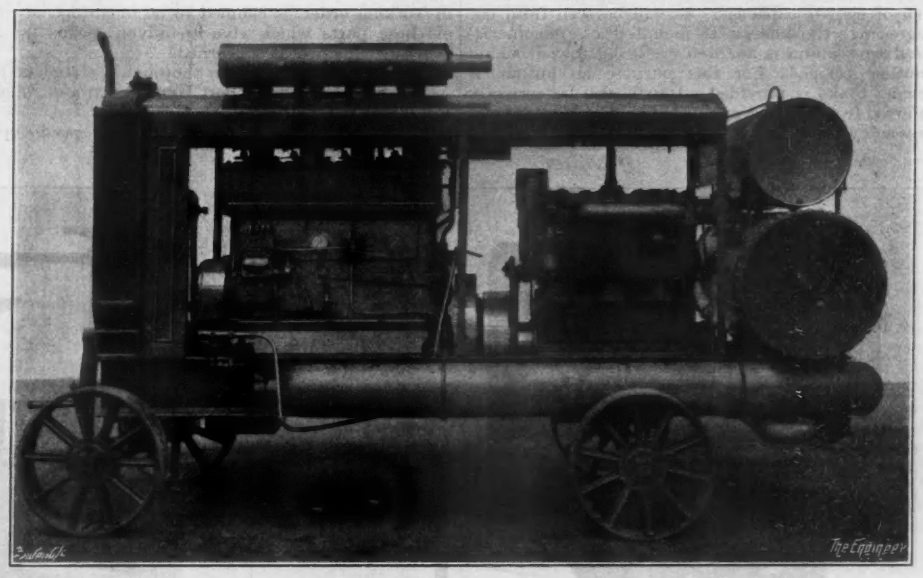


FIG. 20—PORTABLE OIL ENGINE-DRIVEN AIR COMPRESSOR—BROOM AND WADE

In addition to air compressors, the firm is showing a number of pneumatic tools. Mention may be made of a range of pneumatic picks, the weights of which have been reduced as compared with earlier models of the same speed and power. A typical example weighs 24 lb. complete with steel and delivers 1550 blows per minute when the air supply pressure is 80 lb. per square inch.

Lacy-Hulbert and Co., Ltd.

There are a number of interesting devices exhibited by Lacy-Hulbert and Co., Ltd., of Croydon. A very neat and compact little compressor is illustrated in Fig. 21. It is fitted with ball bearings throughout and is made in a range of four sizes with capacities from 5 to 70 cubic feet of free air per minute at pressures up to 45 lb. per square inch. It is suitable for wagons carrying milk and other liquids, sand blasting, and similar purposes, and is claimed to deliver the air practically free of oil. Another small plant suitable for such purposes as paint spraying as well as for hospital work is illustrated in Fig. 22. This electrically driven blower delivers 10 cubic feet of free air per minute against a pressure of 10 lb. per square inch and can also be arranged to act as an exhauster if required. The air is delivered through a filter to which a pressure gauge and safety valve are fitted. The subject of our third illustration, Fig. 23, is the 10 cubic feet paint spraying plant, which we have described before. Certain alterations have, however, been made to increase its convenience when in use and those conversant with the earlier design will see that the position of the delivery pipe has been altered. In addition, an unloader valve has been fitted to the compressor and the crank case has been redesigned and is no longer of the "split" type. The compressor, which is direct coupled to a Lister petrol

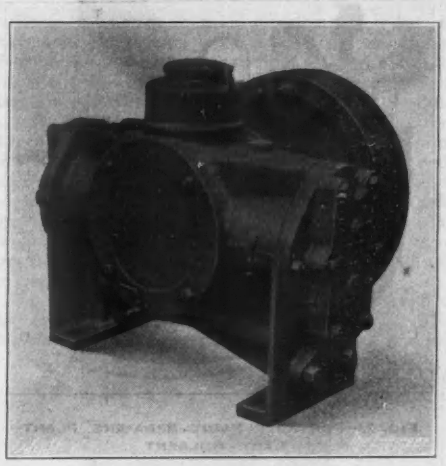


FIG. 21—AIR COMPRESSOR—LACY-HULBERT

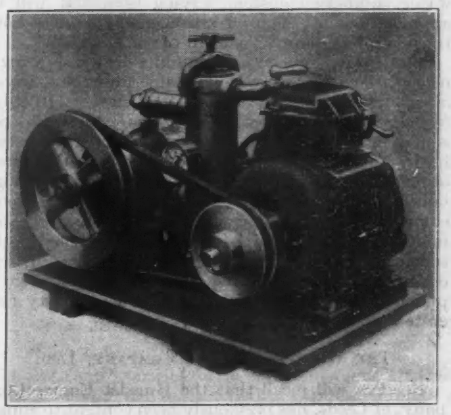


FIG. 22—MOTOR-DRIVEN AIR COMPRESSOR—LACY-HULBERT

engine running at 1280 r.p.m., runs on ball and roller bearings and is said to be exceptionally quiet in operation and to deliver air practically free of oil and moisture. The illustration shows the plant connected

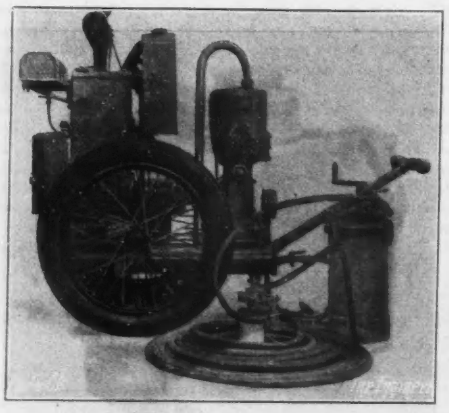


FIG. 23—PORTABLE PAINT-SPRAYING PLANT—LACY-HULBERT

to a two-gallon pressure feed paint tank and spray gun.

AIR PUMPS, LTD.

The portable light-weight petrol engine-driven compressor unit illustrated in Fig. 24 is exhibited by Air Pumps, Ltd., of Emerson-street, London, S.E.1. The unit complete weighs only 11 cwt. and is capable of operating one heavy duty concrete breaker or other tool of similar capacity. As will be seen from the engraving, the chassis is mounted on pneumatic-tired wheels and is adapted for being towed behind another vehicle. For this purpose an automatic towing brake is provided. It will also be correctly inferred from the engraving that the engine and compressor cylinders are cast in monobloc. Two cylinders

FIG. 24—PORTABLE AIR COMPRESSOR—AIR PUMPS

act as the compressor and two as the engine, the water circulation system serving both. It will be appreciated that such an arrangement reduces both the overall size and the weight of the unit.

Besides this light-weight unit the firm is showing a neatly designed two-stage portable oil engine-driven air compressor plant. It has a capacity of 110 cubic feet of free air delivered at a pressure of 100 lb. per square inch and is thus capable of operating two heavy duty concrete breakers. The two-stage water-cooled compressor is claimed to have a very high volumetric efficiency. A little petrol engine-driven compressor with a capacity of 16½ cubic feet per minute and weighing only 400 lb. is designed to be suitable for testing mains, operating a tool for kerb dressing, or paint spraying and the like. A range of pneumatic tools, including silenced heavy duty concrete breakers, is also on view.

THE HUNSLET ENGINE COMPANY, LTD.

Readers will recall that the Hunslet Engine Company, of Leeds, has previously been content to supply the 20 h.p. oil engine locomotive as the smallest of the range produced. It has been brought to the firm's notice, however, that there is considerable demand for a smaller powered locomotive, particularly for contracting work, and there has therefore been designed and manufactured the locomotive illustrated in Figs. 25 and 26. This locomotive is on show at the Public Works Exhibition. The engine is a Blackstone four-stroke unit working at a moderate pressure, and specially designed for traction purposes. It develops 12 h.p. at 1200 r.p.m., and is governed over the full-speed range. A "Hunslet" patent clutch is fitted, together with a four-speed constant-mesh gear-box, with semi-automatic control. The design of the whole of the transmission is based on the experience gained on heavy main line engines made by the firm. The frames are of solid plate construction and the weight of the locomotive, which is about 3 tons

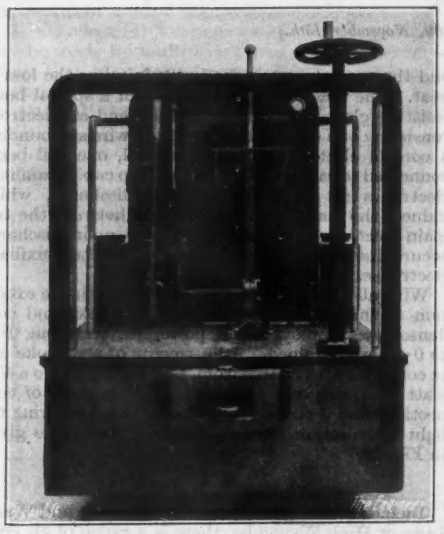


FIG. 25—DRIVER'S PLATFORM—HUNSLET

in working order, is claimed to be made up entirely of those parts which give an advantage as far as general robustness is concerned.

The locomotive has been thoroughly tested under service conditions by Robert Hudson, Ltd., on whose stand it is being shown.

It is made as a two, three, or four-speed type, varying in weight from 2½ to 3¼ tons, and on the low-speed range has a tractive effort of 1600 lb. It can therefore haul a load of about 80 tons, and on the higher speed reach a maximum speed of 13½ m.p.h. The total running expenses of a locomotive of this type, it is suggested, are of the order of about 6d. per day.

One of the illustrations shows the simplicity of the control gear. On the left of this view the large hand lever is that used for reversing Next to it is the speed control lever, and conveniently close the control rod for the sanding gear. The longer lever placed nearly centrally operates the gear change, while the hand wheel on the right is, of course, the brake. As is usual with these makers, the product is very neatly designed.

HADFIELDS LTD.

On the stand taken by Hadfields Ltd., of Sheffield, there is shown the new crushing machine, illustrated in Fig. 27. It is known as the "Shearer" double-action jaw crusher and has as one of its advantages the capability of performing both fine and coarse crushing. It is particularly expected to be useful for the production of concrete aggregate and the various grades of stone used for road making. It is, of course, also suitable for other purposes, such as the reduction of ores. The crusher, as its name denotes, is a jaw type machine, but it differs in several respects from the design of the ordinary jaw breaker. Whereas, in the usual types only one of the two jaws is in motion, in this new machine both oscillate. The jaws are driven from separate excentric shafts at different speeds at rates which cause one to give approximately twice the number of crushing strokes in a given period as the other one. One of the swing stocks is driven at the top end and the other at the bottom and the motion of each is controlled by toggles, the crushing action being such that a good cubical quality product is obtained accompanied by a high discharge rate. The machine is provided with a device whereby adjustments can be effected externally in a few moments to give any size of product desired between

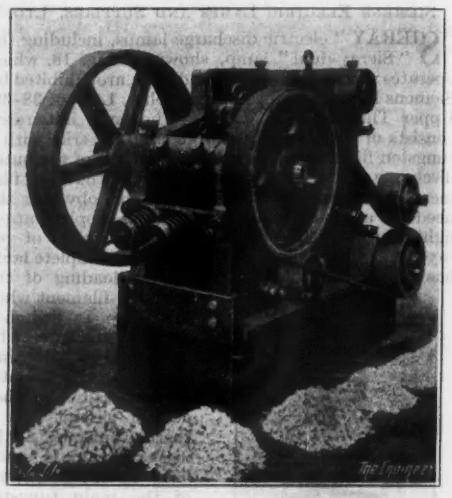


FIG. 27—"SHEARER" DOUBLE ACTION JAW CRUSHER—HADFIELDS

certain limits. As a precautionary measure in the event of tramp metal obtaining access to the breaker, certain features have been adopted in the design to prevent damage to the main structure.

The crushing jaws are reversible and interchangeable and are made in Hadfields' "Era" manganese steel, of which the cheek plates, also, are made. A 24in. by 13in. double toggle jaw stone breaker and a 24in. disc crusher are also among the exhibits.

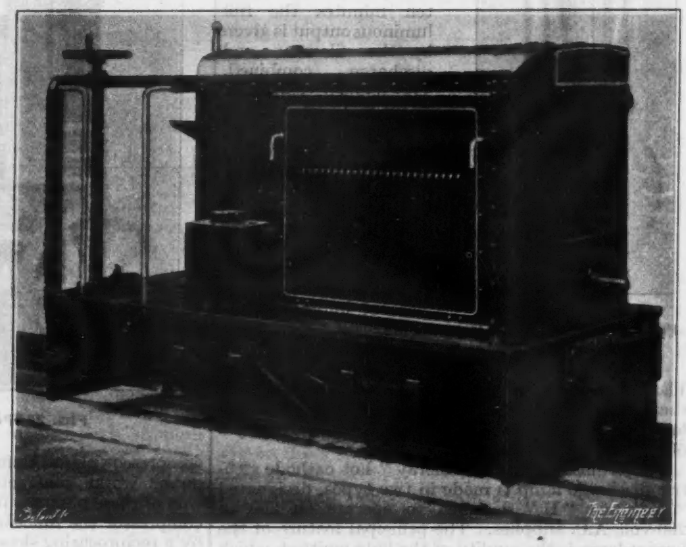


FIG. 26—12 H.P. INTERNAL COMBUSTION LOCOMOTIVE—HUNSLET

AUTOMATIC ELECTRIC COMPANY, LTD.

A large-scale model on the stand of the Automatic Electric Company, Ltd., of Strowger Works, Liverpool, 7, demonstrates the company's latest development in vehicle-actuated traffic control. The system is known as the "Electro-matic Co-ordinated" system, which is claimed to offer important advantages. The model represents a length of road containing a series of six intersections, each controlled by its own local controller. Instead of linking these controllers together by a master timer, as in the past, a new scheme known as "repeater detector impulsing" is employed. Its purpose is to extract the fullest possible benefit from the "reservoir" space between each intersection and to overcome a disadvantage that previously existed when a master controller which took charge of the intersections upon the traffic density reaching a predetermined figure was installed. The disadvantage was the occurrence of a temporary period of confusion owing to the individual controllers being dropped out and then returned into the overall plan in sympathy with the increases and decreases in the traffic density. While the density may fall below the predetermined level at one individual intersection, it may be far above it at another intersection, and it is this circumstance which had led to the introduction of repeat impulsing. With its aid the traffic units crossing the detector at one

intersection not only announce their presence at that intersection, but send in addition a warning of their imminent arrival to the next intersection ahead in their line of travel.

It is therefore possible for one intersection to be devoid of traffic and yet to have its controller recording the passing of a large volume of traffic. In this circumstance the intersection is temporarily barred to further traffic and the right of way is transferred to the next intersection ahead, so as to permit uninterrupted progress for the heavy volume of traffic which has been announced as on its way. The introduction of repeat pulsing with its method of always operating one intersection ahead of the traffic thus provides smooth progression for main road traffic without subjecting it to the arbitrary and unsympathetic control of an external master timer. Should special conditions in an area make a fixed progression desirable, repeat pulsing can be employed with a master timer, for the local controller will then be responding more closely to the average variation in traffic density and rapid fluctuation of traffic flow will be smoothed out in consequence. Another exhibit demonstrates the control of pedestrian crossing signals by means of a photo electric cell and light beam.

C. H. Johnson and Sons, Ltd.

In the illustration—Fig. 30—and the drawing—Fig. 31—we show the Kangarammer, a device made by C. H. Johnson and Sons, Ltd., of Manchester, 8. This tool, as its name implies, is a rammer, but it is adaptable to other purposes, notably road-breaking and light pile driving. Unlike pneumatic tools for the same classes of work, it is entirely self-contained and works on the internal combustion principle. The firing of the charge in the cylinder causes the

FIG. 30—THE "KANGARAMMER"—JOHNSON

piston to be forced downwards against the pressure of a return spring, and the whole device is thereby made to "jump" about 18in. Ramming is effected by the drop from this height and by the weight of the tool, which, according to the size in use, is 140 lb. or 230 lb. Pure benzole is carried in a tank at the base of the tool. Steel wire metal sponges and steel spiral wire contained in the tank form a simple, but efficient, carburetter. On the downward suction stroke of the piston gas is drawn into the cylinder through hollow rods on each side and a valve in the cylinder head. Exhaust takes place through a valve in the piston. It will be observed that the piston itself is loose on the rod; the exhaust valve is closed when the piston and rod are in contact and open at other times. On the cylinder head there is an air inlet adjusting screw, by the use of which the correct richness of mixture can be obtained. The mixture is fired by a sparking plug controlled by a press button. Each time this button is depressed an explosion occurs, and the tool is "jumped." About sixty blows can be delivered per minute. This rate of action is, of course, slower than that of a pneumatic tool, but it is claimed that each blow is heavier and that the rate of consolidation is equally rapid and more effective. The operator carries on his back an electric accumulator from which is derived the current for the sparking plug. It is said that the rammer is very simple to use and that unskilled navvies can be taught how to use it in a very few days. As far as consumption is concerned, half a gallon of benzole will keep a 230 lb. machine in use for about eight hours. Inclusive also of lubricating oil charges and the cost of recharging the electric battery every fortnight, the cost of operation is said to work out at about 2½d. per hour. By adaptation of the base, the machine can be made suitable for concrete breaking and similar purposes, and is said to be very considerably quieter in use than pneumatic tools. After the chisel or other tool has been driven in sufficiently far the rubber loop connected by a wire rope to the chisel—see Fig. 30—is hung over one of the handles. At the next "jump" the chisel is brought up, and while it is clear of the

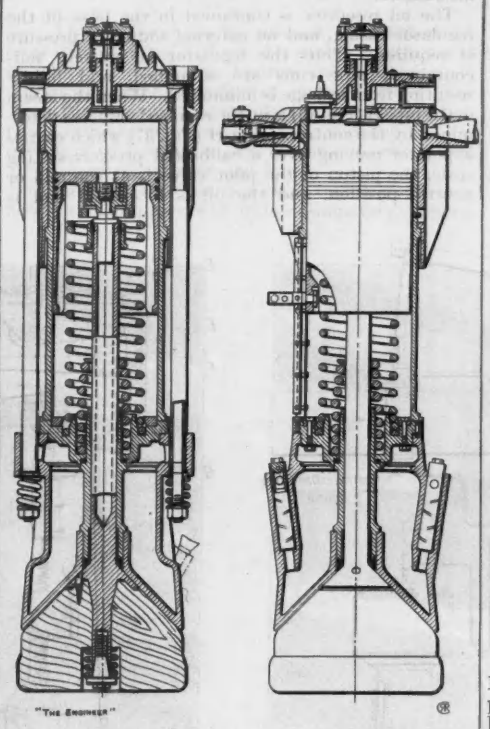


FIG. 31—DESIGN OF "KANGARAMMER"—JOHNSON

ground the tool is swung to bring the chisel into contact at another point. By the use of a suitable rig the machine can be used as a light pile driver.

Another illustration—Fig. 32—shows the "Frog" rammer. In many places consolidation by the use of a steam roller is impossible. The ½-ton "Frog" illustrated operates on the same principle as the rammer just described. It "jumps" 12in. to 15in. and gives about sixty blows per minute. By giving a forward inclination to the cylinder the device is caused to move forward about 6in. at every jump. The capacity of the "Frog" is about 400 cubic yards per hour, and the cost about 10d. for the same period.

Ruston and Hornsby, Ltd.

There are several interesting exhibits on the stand taken by Ruston and Hornsby, Ltd., of Lincoln. Two oil-engine-driven locomotives, suitable for public works contractors or quarry owners, or the like, are of 18/21 and 36/42 h.p. respectively. Both locomotives are provided with three speeds in either direction. The gear wheels are in constant mesh and the changing of the gear is effected by a single lever operating in a gate, no foot action being necessary. Interchangeable steel roller chains take the drive to both axles, and in order that there shall be no chain snatch the method of springing is so arranged that the driving axles move up and down on a radius around the inner chain sprocket.

One of our illustrations—Fig. 28—shows one of the two horizontal oil engines exhibited. This machine develops 80 b.h.p. in two cylinders, and will

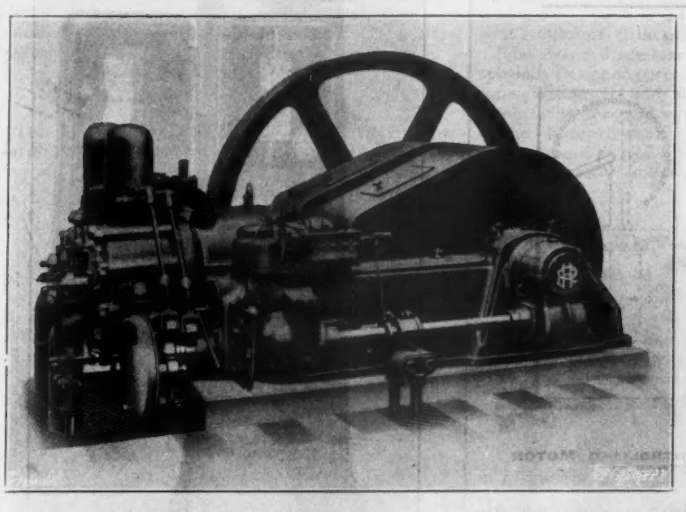


FIG. 28—80 B.H.P. HORIZONTAL OIL ENGINE—RUSTON

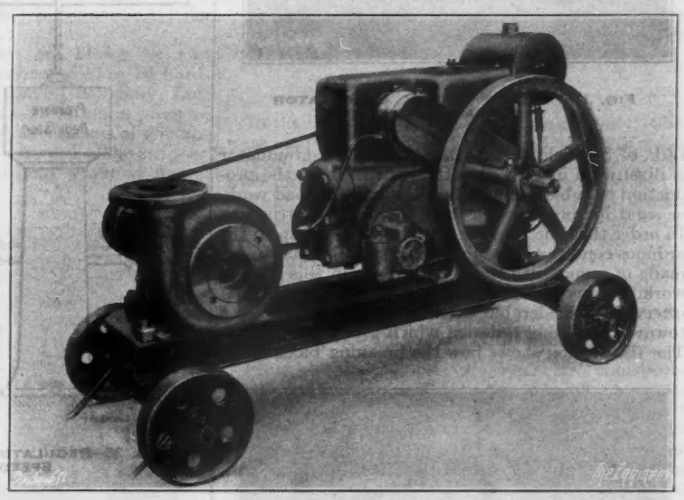


FIG. 29—PORTABLE PUMPING PLANT—RUSTON

operate satisfactorily on low grades of fuel. This type of engine is made in single, double, and four-cylinder arrangements up to 264 b.h.p. The general features of the design are clearly shown in the illustration, and the operation of the engine will be demonstrated on the stand by a sectional model. Besides these horizontal engines the firm will be showing a 52 b.h.p. vertical oil engine mounted on a steel frame and coupled to a centrifugal pump. The assembly is designed to be portable and is particularly suitable for use on large public works contracts. The engine is a three-cylinder unit running at speeds up to 1000 r.p.m.

A neat, portable pumping plant is illustrated in

FIG. 32—"FROG" RAMMER"—JOHNSON

Fig. 29, and consists of a single-cylinder, petrol-paraffin engine driving a centrifugal pump through a belt. Several similar portable plants are on view, among which a 3in. diaphragm pump mounted on a steel truck and driven by a petrol-paraffin engine is particularly interesting. The firm claims that this unit is particularly quiet in operation and notably free from water splash from the bucket.

As readers will be well aware, the firm manufactures a wide range of products. Besides the plants already mentioned, there are shown a "Thermax" vertical water-tube boiler suitable for a working pressure of 120 lb. per square inch, and having an evaporative capacity of 890 lb. per hour, and a series

of air receivers principally intended for the storage of compressed air for starting oil engines and having capacities from 3·25 up to 23·38 cubic feet for pressures up to 350 lb. per square inch.

EDGAR ALLEN AND CO., LTD.

Crushers, granulators, screening plant, and a clay cutter will be exhibited by Edgar Allen and Co.,

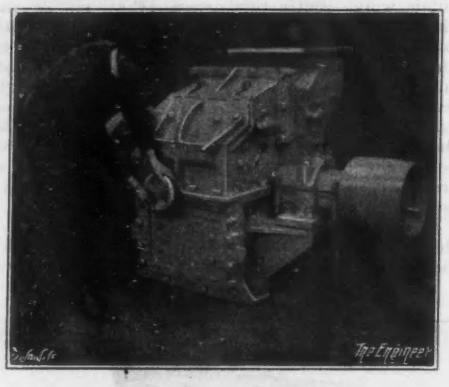


FIG. 33—"STAG" ROTARY GRANULATOR—EDGAR ALLEN

Ltd., of Sheffield, 9. A Stag K B rotary granulator is illustrated in Fig. 33. It is intended for the production of cubical stone and chippings for road work, or sand for public works and building construction. In order that the working parts may stand up to the arduous conditions, the liners and breaking blocks are made of manganese steel, while since in this kind of work various parts must necessarily be renewed at intervals, considerable attention has been directed towards obtaining a design which gives accessibility. The illustration shows how the breaking blocks may

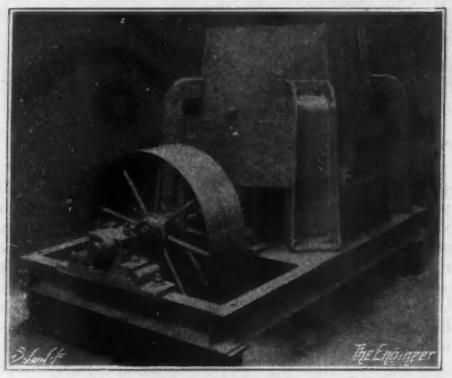


FIG. 34—"STAG" CLAY CUTTER—EDGAR ALLEN

be adjusted. The Stag jaw granulator exhibited has a mouth opening of 16in. by 6in., and is built with a heavy cast iron body. The swing jaw stock is made of cast steel, and the renewable jaw faces of manganese steel.

The second illustration—Fig. 34—shows the Stag clay cutter, a machine designed for breaking up and feeding wet clays in brickworks, the clay-drying industry, and, in fact, ceramics generally. The machine exhibited has a capacity of 1 to 2 tons per hour.

ELECTROFLO METERS COMPANY, LTD.

Two pressure regulators are among the exhibits of Electroflo Meters Company, Ltd., of Abbey-road, Park Royal, N.W.10. One, shown in Fig. 38, is for controlling gas and air at relatively low pressure; while the other (Fig. 36) is a high-pressure regulator for operating a reducing valve. Both models operate on the same principle. Referring to Figs. 36 and 37, the steam in the pipe A to be maintained at constant pressure is transmitted through the piping B to the diaphragm C of the regulator (Fig. 36). Movements of this diaphragm are transmitted to the coupling D, and by means of magnifying levers and links E and F to the thrust rod G, the system being maintained in compression by an adjustable spring H, which

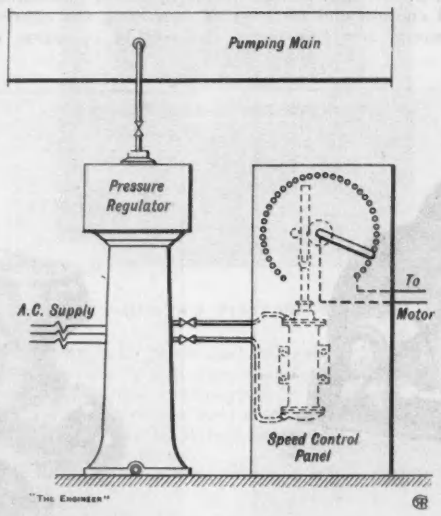


FIG. 35—REGULATOR CONTROLLING MOTOR SPEED—ELECTROFLO

determines the required steam pressure. As the pressure varies, the thrust rod G is depressed or lifted in proportion to the departure from the required value. Friction and back lash are vertically obviated by mounting the transmitting levers on ball bearings. The thrust rod G is connected to the piston J of the pilot valve K, which acts as an oil servo-motor and regulates the flow of high pressure oil through pipes (indicated in Fig. 36) leading to a double-acting hydraulic cylinder X. The oil is delivered by an electrically driven pump at a pressure determined by the power required to operate the controlling mechanism.

The oil reservoir is contained in the base of the regulator casing, and no external source of pressure is required. Thus the regulator is entirely self-contained, pipe runs are simplified, and failure resulting from leakage is minimised. When the steam in the pipe A (Fig. 36) is at the required value, as determined by the control spring H (Fig. 37) which carries a pointer moving over a calibrated pressure-setting scale, the piston of the pilot valve is at the mid or neutral position, and the oil is by-passed and is consequently ineffective. When the pressure changes, however, the diaphragm is deflected and moves the piston J, which opens one of the directional ports of the pilot valve, so that the oil is directed to one end of the hydraulic cylinder and flows out at the other end, thus altering the position of the valve (Fig. 36) until the correct pressure is regained, when further movement ceases. The action of the regulator is claimed to be remarkably responsive and stable.

This result is achieved in a special manner. The pilot valve is so designed that following known hydraulic laws the piston supported between two springs L and M oscillates when the oil flows, and the amplitude of oscillation varies directly with the amount of restriction to the flow of oil through the ports. In effect, the oscillation is greatest when the piston, and consequently the diaphragm, is near its

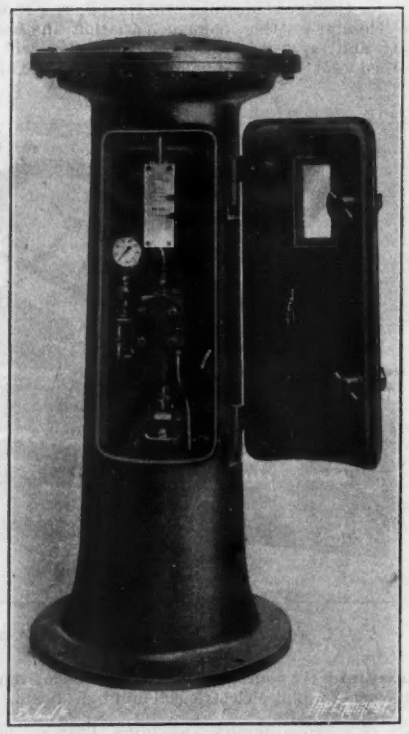
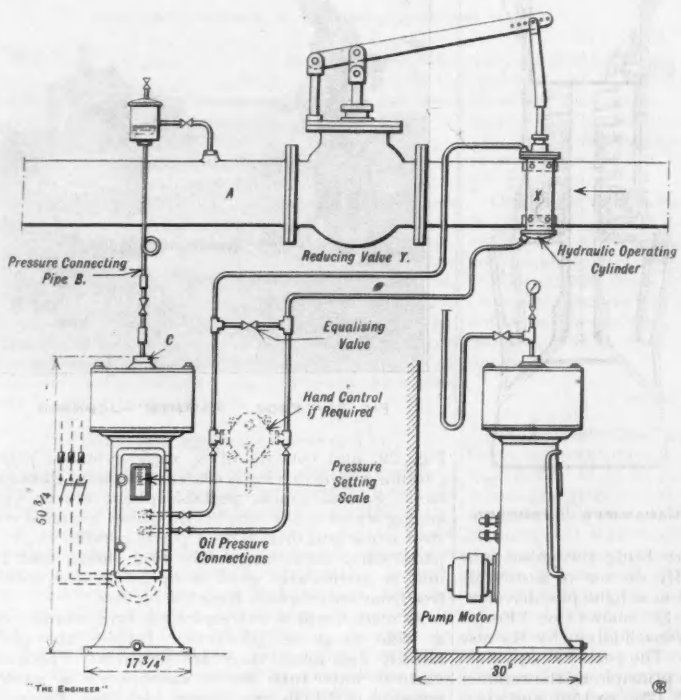
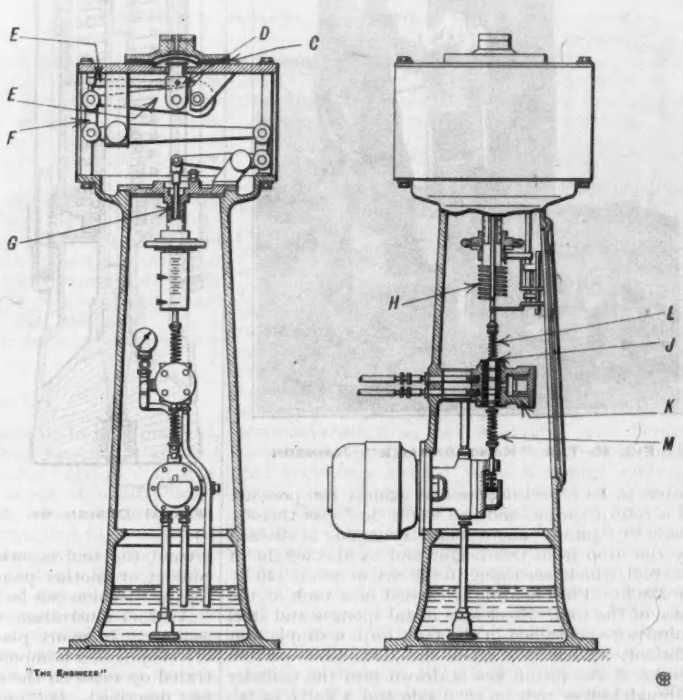


FIG. 38—PRESSURE REGULATOR—ELECTROFLO

mid-point; that is to say, when the pressure is at the correct value, whilst when the pressure has departed perceptibly from that value the oscillations are reduced. According to their magnitude, these oscillations interrupt the flow of oil to and from the hydraulic cylinder, retarding or accelerating the movement of the power piston as the pressure becomes near to or departs perceptibly from normal. The rate of movement of the valve or other controlling mechanism is therefore not constant, but varies in accordance with the magnitude and rate of pressure change. If a sudden pressure change occurs, the valve moves fast initially, but slows down as the normal pressure is approached. A very small pres-





FIGS. 36 AND 37—OPERATING CONNECTIONS AND DESIGN OF PRESSURE REGULATOR—ELECTROFLO

sure change causes a correspondingly small valve readjustment.

As the illustrations indicate, the design of the regulator is simple, and all moving parts are accessible for adjustment and inspection. The piston of the pilot valve is free within its sleeve, and as it is continuously flooded with oil, wear and friction are virtually eliminated. When the apparatus is employed for controlling low pressures the diaphragm has a larger area, and is directly connected to the thrust rod, the deflection of the diaphragm being sufficient to move the piston without magnifying levers. The diaphragm can also be arranged differentially for flow regulation or for the proportioning of the volumes of two gases of different calorific values. A simple application of the regulator is its employment for the control of pressure by regulating the speed of motor or turbine-driven fans, compressors, pipes, &c. Such an arrangement is shown in Fig. 35, where the power cylinder is coupled to a rheostat on the control panel by means of a rack and pinion.

(*To be continued.*)

Corby Iron and Steel Works.

No IV.

(*Concluded from page 510, November 15th.*)

IN the preceding three articles we have dealt with the blast-furnace, coke oven, and by-product plants, and we now pass to the basic Bessemer steel plant and the strip mills, which combine the latest features of British and Continental practice.

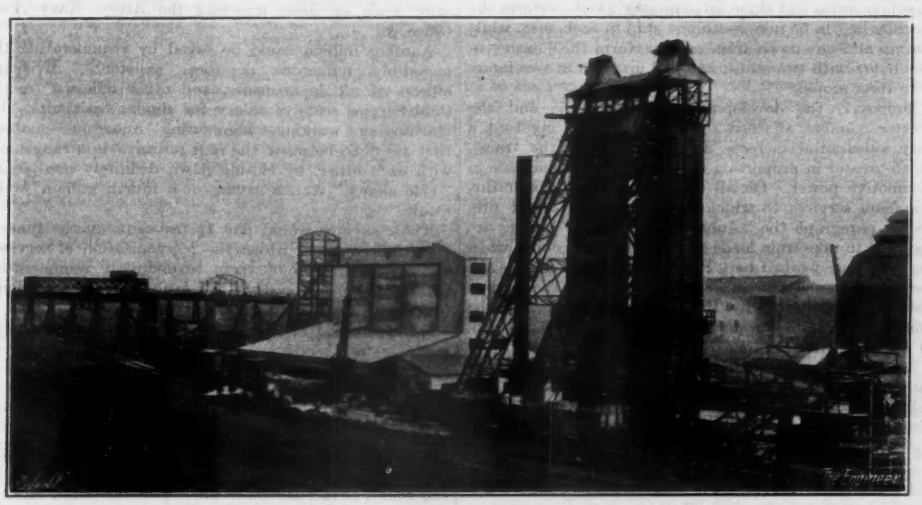
Basic Bessemer Plant.

The basic Bessemer plant was constructed by Pearson and Knowles Engineering Company, Ltd., of Warrington, in collaboration with Gutehoffnungshütte; Head, Wrightson and Co., Ltd., Thornaby-on-Tees, in collaboration with Bamag; and the Wellman Smith Owen Engineering Corporation, Ltd., of London; and consists of three converters, each having a capacity of 25 tons with a maximum capacity of 28 tons. The converters are of special design, and a number of new improvements have been incorporated in the plant to facilitate operations. The converters are supplied with molten pig iron from a 1000-ton mixer of special design to conserve heat. The mixer is electrically operated and fired by automatically controlled coke oven gas burners, one at each end with an auxiliary gas burner at the spout. The mixer is charged with hot metal by means of a 150-ton crane, the metal being brought directly from the blast-furnaces in 60-ton ladles. The metal is weighed before entering and after discharging from the mixer.

The following gives an average analysis of the iron as charged into the converters:—Silicon, 0·5 per cent.; manganese, 1·3 per cent.; phosphorus, 1·9 per cent.; sulphur, 0·05 per cent.

The basic Bessemer vessels are blown by two specially designed turbo-blowers, supplied by Richardsons, Westgarth and Brown, Boveri Company, Ltd. Each set is designed so that the variation in pressure at the blower discharge is used as a means of governing the speed at which the blower runs. The air pressure is thereby maintained at any required figure. The blowers have fixed diffusers and automatic blow-off valves, so as to enable stable conditions to be obtained when the blowers are delivering an output of 10,000 cubic feet of air per minute. The steam turbines are of the standard single-cylinder combined impulse and reaction type, and suitable for operating with steam at 350 lb. pressure per square inch, superheated to 600 deg. Fah.

Housed in the turbo-blower building are the necessary high-pressure hydraulic pumps for supplying hydraulic power for the tilting of the converters. These consist of two Mather and Platt high-pressure pumps, each being designed to deliver 450 gallons of water per minute against a head of 2400ft. One of these pumps is driven by an electric motor, while the other is steam driven. The steam is supplied from two Babcock and Wilcox boilers, generally similar to those at the blast-furnaces, and also fitted with complete automatic control.



BLAST-FURNACE GAS-FIRED LIME KILNS

The main Bessemer building (see the view reproduced in to-day's Supplement) is 560ft. long, and contains two 50-ton cranes in the pouring bay, together with a 15-ton underhung jib crane. These cranes were supplied by the Wellman Smith Owen Engineering Corporation, Ltd.

There are two electrically driven 50-ton floor type ingot-casting machines, which run on a wide gauge track paralleling the converters. They carry 25-ton steel ladles which take the steel from the vessels and cast it into the ingot moulds carried on ingot bogies. The ingots are transferred from the basic Bessemer shop to the stripping bay by steam locomotives.

Lime-burning Plant.

On this page we reproduce a view of the blast-furnace gas fired lime kilns, which are arranged near to the Bessemer plant. These kilns provide the lime required in the basic steel process, and they were supplied by Priest Furnaces, Ltd., of Middlesbrough. Each kiln has a designed output of 80 tons of burnt lime per twenty-four hours. The lime is transported to the Bessemer plant in special containers, and stored in bins adjacent to the Bessemer house. It is handled by two 20-ton Broadbent cranes.

Rolling Mill Plant.

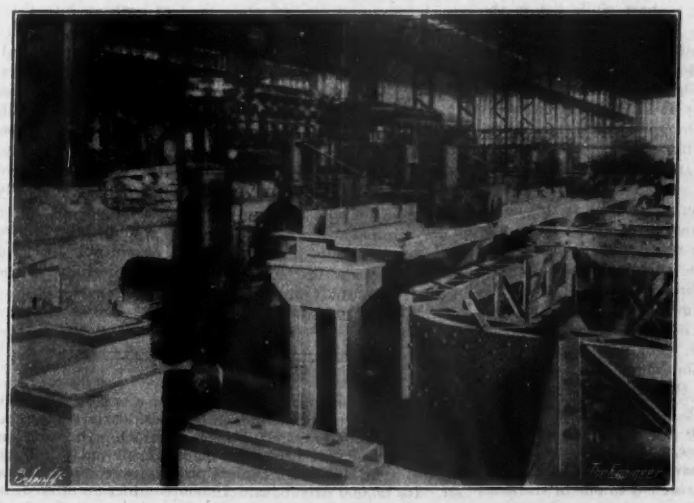
In the Supplement we show the soaking pits, which were supplied by Priest Furnaces, Ltd., of Middlesbrough. They comprise four pits designed to operate with mixed gases, in which regenerators are used to preheat the air and metal recuperators to preheat the gas. The proportion of blast-furnace and coke oven gas in the gas mixture supplied to the pits is automatically controlled, and can be varied between wide limits. The rolling covers are electrically operated.

Blooming Mill and Shears.

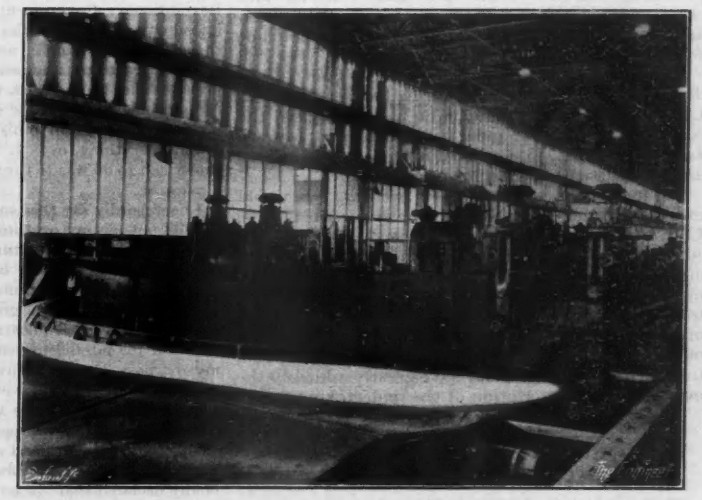
From the soaking pits the ingots are transferred by an electrically propelled bogie to the 40in. reversing blooming mill. Two views showing the front and back of the mill in operation are reproduced on page 542. This mill is driven by a 10,000 h.p. reversing motor, operated by an Ilgner set, which was transferred from the Clydesdale works of the company, where it was attached to the universal plate mill. A special feature consists of electrically operated manipulating gear supplied by Schloemann, which includes one electric manipulator at the front and back of the mill and a patented tilting device, both in front and at the back of the mill, for tilting the bars to be fed into the diamond passes. Immediately at the front and back of the housings are individually driven rollers. Buildings, cranes, and run-out tables of this mill were also transferred from the universal mill at Clydesdale. Details of these arrangement are shown on page 542.

From the blooming mill the bars are transferred by roller table to an up-cutting hot shear for cutting slabs up to a maximum of 192 square inches. These shears are capable of exerting a shearing pressure of 720 tons, and the adjustment at the top blade is effected electrically.

Incorporated at either side of the shears is a device for removing the sheared ends. The cut blooms and bars are transferred from the shears to a cooling rack in the billet storage building, which is arranged between the blooming mill and strip mill buildings. After inspection, the billets pass into two continuous billet reheating furnaces or into stock for shipment.



STRIP COILERS WITH REHEATING FURNACES IN BACKGROUND



HORIZONTAL LOOPER BETWEEN INTERMEDIATE AND FINISHING STANDS

Reheating Furnaces.

The two reheating furnaces, which are shown in one of the Supplement views, were supplied by the International Heat Economy Bureau, Ltd., London,

and are of the metal recuperative type, and are designed for an output of 20 tons each per hour. They can be fired on a mixture of blast-furnace and coke oven gas having a calorific value up to 180 B.Th.U. per cubic foot. These furnaces are the first to be built in this country with all-metal recuperators.

The gas is preheated to 400 deg. Cent. in a specially designed metal recuperator. The air recuperator which is of the plate type, preheats the air to 250 deg. Cent. The mean temperature of the recuperators when using straight blast-furnace gas is kept lower than when preheating gas or air only. This procedure ensures a longer life of the recuperator elements. The blooms are carried down the furnace on a patented system of water-cooled skids and the burners are designed for low pressure and require no water cooling. The fuel consumption per ton of cold billets heated varies between 1·3 and 1·4 million B.Th.U. on normal load. The heated blooms are ejected from the furnace on to a roller table on which they are conveyed to the strip mill.

The Strip Mill.

The strip mill is a combination of cross-country and continuous type. It has eight horizontal and four vertical edging stands, and is capable of rolling strip from 2⅝in. to 15½in. wide, with fine tapered edges. The first stand consists of a 22in. three-high roughing stand, with one tilting table at the back of the stand. In line with this first stand is a second three-high 22in. stand, and both are driven by one motor through a speed-reducing gear. This latter stand is equipped with a special design of vertical repeater. From the second roughing stand the piece is conveyed on a roller table through the first set of vertical edging rolls to the third or intermediate stand, with rolls of 19in. diameter. A horizontal looper—see p. 539—connects this stand with a fourth intermediate 19in. stand, and thence to a group of four continuous three-high finishing stands.

There are three electrically driven vertical edging stands in the finishing mill, which are interchangeable, and can be placed in front of any intermediate or continuous finishing stand.

Leaving the last continuous finishing stand, the strip is led directly into two electrically driven horizontal type coilers, which coil the strip up to a width of 12in. These are shown on p. 539. There is a novel feature in that the strip enters the coilers whilst it is still in the mill and running at the maximum speed. After coiling, the finished coils (see to-day's Supplement view) are automatically transferred to a continuous cooling conveyor on which they are inspected and examined ready for transfer to the tube mill by means of a special electric locomotive.

Water and Power Supply.

The water supply for the works is obtained from Blatherwycke Lake, distant some 8 miles. On entering into the main works supply reservoir, it is treated for distribution at the various units, utilising either hard or soft water, and approximately 1,000,000 gallons of make-up water daily are used.

The main power supply for the undertaking is taken from the National Grid by special overhead lines terminating in an outside sub-station. The current is supplied at 11,000 volts, and is transformed down to 3000-volts and 415 volts, and distributed to to various sections of the works. The principal suppliers of electric equipment, including transformers, switchgear, and mill motors, were the Metropolitan-Vickers Electrical Company, Ltd., and the English Electric Company, Ltd.

Modern engineering shops, and central offices are provided, together with up-to-date research and chemical laboratories, and the whole lay-out has been arranged so that extensions to any part of the plant can be conveniently carried out.

All the plant we have described was built to the designs and specifications of H. A. Brassert and Co., Ltd., of Walbrook, London, who also supervised the construction, and are, under the direction of Stewarts and Lloyds, Ltd., in charge of operations in the iron and steel sections of the undertaking.

In concluding this series of articles, we would express our indebtedness to Stewarts and Lloyds, Ltd., H. A. Brassert and Co., Ltd., and to several subcontractors for particulars and illustrations placed at our disposal. In this connection special mention may be made of the very artistic and interesting technical photographs which were specially taken, often under difficult conditions, by Mr. F. S. Lincoln, of New York, and Mr. R. W. Brown, of Birmingham, for Mr. H. A. Brassert, and have greatly added to the interest of this description of the undertaking.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

FAST TRAINS.

Sir,—The interesting correspondence under the above title which has latterly been conducted in your columns has included several references to the express service over what is now the London, Midland and Scottish Railway's route between London and Birmingham, and I should like your indulgence to correct several misconceptions of fact or inference therein contained.

In his letter published in your issue of October 25th, Mr. W. B. Thompson alluded to the present 1 h. 55 min. timing between Birmingham and Euston being in force in August, 1902. This is not correct, as the fastest advertised booking at that time was two hours (non-stop Birmingham to Euston by the 5 p.m. express from New-street). The fastest down timing was 2 h. 5 min. by the 6.55 p.m. from Euston, a similar timing also being in force by the 11.25 a.m. up train from New-street.

It is quite correct that on August 1st, 1902, the 5 p.m. train from Birmingham, consisting of five bogie coaches (about 130 tons) hauled by the Webb four-cylinder, compound engine "Francis Stevenson," made the non-stop run to Euston in a few seconds under 1 h. 55 min. But if Mr. Thompson is to quote this instance as evidence of a lack of improvement in the Euston-Birmingham services over the intervening thirty-three years, it is surely not too much to ask of him that his criticism should embrace all the factors relevant to his case.

In the first place I would point out that the two hours schedule of 1902 was made by one train in one direction only, making a non-stop run. Post-war commercial considerations have dictated the introduction of one or more stops on all the important expresses between Euston and Birmingham, and *vice versâ*, and while it is true that the journey might be performed in a few minutes' less time were it to be made non-stop, the additional mileage involved in running duplicate trains to give an equivalent service to these intermediate points (principally Coventry) would not be justified either by the small economy in time or by the heavy additional cost.

The fact remains that whereas in 1902 there was only one two-hour train on this route (non-stop), there are now four down and three up expresses which perform the journey in 1 h. 55 min., with one stop in each case, while one up and one down train each perform the journey in two hours with two stops, and one up train in two hours with three stops.

Moreover, the development of the traffic and the greater comfort afforded to passengers has involved a very substantial increase in the weight of the trains, much greater in proportion than has been the increase in locomotive power. On all the L.M.S. London and Birmingham services to which I have referred in the preceding paragraph the "Jubilee" class 4–6–0 engines are required to take train loads of 350 tons unassisted; when the trains are worked by "Royal Scot" class engines the permitted tonnage is considerably heavier. The load of the train referred to by Mr. Thompson as making the non-stop run from Birmingham to Euston in 1 h. 55 min. in 1902 was only 130 tons.

I should be glad if you would be good enough to give publicity to this letter, as the facts, when presented in full and in their proper light, place on the matter a very different complexion to that suggested by your correspondent.

For the L.M.S. Railway Company,
Loftus Allen.

London, N.W.1, November 15th.

SCIENCE AND THE CITIZEN.

Sir,—*Apropos* of your remarks on Major Freeth's address at the luncheon of the British Cast Iron Research Association, I, for one, have particular reason to endorse your opinion that, notwithstanding the large part played by mechanical science in the social life of to-day, the ignorance that prevails respecting that science, even among the most intelligent members of the community, is intense.

A few years ago I wrote a short historical tale. Its theme (which, I flatter myself, would have disgraced neither Mary Shelley nor Edgar Allan Poe) was an instrument of execution supposed to have been used by the French Revolutionary Government for a short while before the introduction of the guillotine. This machine (to quote the words of my story) "avoided all the horrors generally associated with putting people to death. The condemned man was simply deposited, with his coffin, in the machine; the machine itself did the rest. It killed him painlessly, laid him out, put him in his coffin, and screwed him down. It did everything, in fact, but bury him. All the executioner had to do was to turn a handle communicating with *a machine*."

I need hardly say that such an instrument as this never existed outside my own imagination, and that there was never any question of utilising any lethal device during the French Revolution beside that proposed by Dr. Guillotin. But, apart from its many historical solecisms, my story contained a gross mechanical solecism that should alone have debarred it from any publication intended for intelligent readers. For it was essential to my purpose that my invention should be as handy, compact, and inexpensive as the guillotine itself, and therefore, apart from the vague hint that I have aready quoted, I avoided all mention of the primitive steam engine, engine-house, and stoker, without which no such instrument could possibly have operated. Indeed, I boldly declared that "a lever attached to one of the sides was all the mechanism visible."

Such, however, is the widespread ignorance of the simplest facts concerning machinery that not one of the editors to whom the story was submitted (and it was published four times) called the motive agency of my contrivance in question. Nor did these gentlemen belong to the lesser fry of their profession. One of them controlled a magazine of great antiquity and repute, and each of the others was connected with a leading metropolitan or provincial journal.

The truth is that, notwithstanding the use of the motor car, the wireless telegraph, the refrigerator, and other mechanical appliances in everyday life, the non-technical part of the public still assumes that machinery works spontaneously.

A. E. Sullivan.

London, November 13th.

RAILWAYS AND UNEMPLOYMENT.

Sir,—Your informative article on this matter will cause many to doubt whether the Government's plans, which, in effect, force the railways to spend £55,000,000 on work which is largely unnecessary, are a good way of assisting unemployment.

The plans suffer from the disease of most political palliatives, they "rob Peter to pay Paul," Paul, in this case, being the hundreds of thousands of unfortunate dividendless railway stockholders, whose capital to the extent of some £270,000,000 has received no dividend for several years past. Many millions of holders of Preference stock also have only received part of the dividend to which they are entitled. The expenditure at the behest of the Government of these additional millions, raised by debentures, places the hope of a dividend on ordinary stocks still further in the background.

Government help for unemployment should be a charge on national revenue, and not on that of privately owned railways. This could be arranged by Government receiving the income from the railways. Without going into details, roughly two millions a year could be saved. Some items are £450,000 Railway Clearing House; £70,000 directors; the substitution of one secretary, manager, engineer, mechanical engineer, accountant, &c., in place of the four of each now employed. The payment of each of the Government officers to be on same scale as those directing the Army, Navy, Post Office, &c.

Another million could be saved by remunerating the incredibly numerous deputies, assistants, divisional officers of all departments, and other officials, on the Civil Service scale of salary for similar assistants. By rearranging working, eliminating numerous matters that are done between the four railways in arrangement with each other, by closing down definitely non-paying "side shows," &c., a saving of a fourth million would result.

These savings would pay 1½ per cent. on the present dividendless stock, whilst the reorganisation of services, and the restriction of them to definitely remunerative transport, would produce the saving of the additional four millions a year to pay 3 per cent.

All this could be done without any reduction of the working staff.

G. A. Nnokes.

Burgess Hill, Sussex, November 19th.

DOMESTIC REFUSE DISPOSAL.

Sir,—In the perfect city of the future, domestic refuse will be transported in underground channels, either by air, water, or mechanical means. The dustbin, breeder of flies and ailments, will disappear from our backyards and our curbstones. An offensive trade will be removed, and the municipal dustcart with its attendant myrmidons will no longer rumble through our streets.

But that is far off. Not even in the best-conceived building estates has provision been made for garbage channels, and the dustbin, but one degree better than the ashbin under the garden or area stairs, still remains an offence to all our senses. As it must be endured, can we do something better of the same order? May I ask if in any municipality paper-bag "bins" have been tried? Bags of a suitable kind and size are now regularly made for cement, and presumably they are very cheap. A suitable rack to hold three or four could be devised, with a lid covering and hiding all. The dustmen would throw the bags complete with their load of garbage into their carts, and the noise and air poisoning which results from bumping and tipping the iron dustbins would be removed.

On another point—for the consideration of engineers. There are in this country some millions of small villas, each with its garden. Every garden, however small, accumulates leaves, twigs, cuttings, dead plants, *et hoc genus omnes*, which can only be got rid of by burning, for ten to one the dustmen will refuse to accept them. But fires are an abomination in small gardens in a densely built area. Could not our agricultural engineers devise a very simple and cheap baling press which would reduce this garden rubbish to "ingots" of suitable size for dropping into a dustbin or even burning, usefully, in the house? I doubt if any binder would be required.

November 19th. Domesticus.

Public passenger transport by road was paid a compliment by Sir Cyril Hurcomb in his presidential address at the Institute of Transport on October 14th. He said that the ability and enterprise of its management and its willingness to avail itself of technical progress were apparent to all. Its 90,000 drivers and 70,000 conductors offered, in general, an example of competence and care on the road. It had made an immense difference to the lives of vast numbers of people whose geographical isolation was at an end. The country omnibus and motor coach services had done for them physically what the British Broadcasting Corporation had done for them mentally and spiritually. The number of vehicles owned by licensed operators at the end of 1934 was over 45,000, and, apart from the express or long-distance coach services, the public was content to pay about one million sterling a week for the services.

Rail and Road.

A RUMOUR that under the plan for a new Euston terminus St. Pancras was to cease to be used as a passenger station and that 2400 houses would be torn down was emphatically denied by Sir Josiah Stamp on November 14th.

THE locomotives, rolling stock, and plant, but not the permanent way, of the Lynton and Barnstaple disused railway were sold by auction on November 13th. The four tank locomotives realised £52, £55, £34, and £50 each. Their name plates, which are after North Devon rivers, had been removed in order to be placed in the Railway Museum, York.

WHEN Crewe was made a railway centre by the London and North-Western Railway in the early 'forties, that company provided, among other amenities, a library which has since been subsidised from railway funds. The L.M.S. Company now proposes to stop this contribution and has offered the books, valued at £10,000, as a gift to the Crewe Corporation, and its building at a nominal rent. The matter is now under the consideration of the Corporation.

THE recent opening, by Pickfords, Ltd., of a new sorting depôt and headquarters at Willow Walk, Bermondsey, gave Sir Josiah Stamp an opportunity to give some details of the origin of that firm's long service in the cause of transport. They started in the reign of Charles I, carrying goods by packhorse till roads were developed, when they started a wagon service between London and Manchester. In 1777 this service ran twice weekly and covered the distance in 4½ days, the fastest goods service of the time. Later, this was increased to a daily service, which left the White Bear Inn, London, every afternoon at 4 o'clock.

THE engine and some of the following vehicles of a train conveying vans carrying empty milk churns were derailed whilst running between Winchfield and Hook, on the Southern Railway, on the morning of Sunday last, November 17th, owing to distortion of the track by a landslip. All the four main lines that run between Woking and Basingstoke were obstructed. None of the three trainmen were seriously hurt, although the guard had a narrow escape, as his van was destroyed. The landslip was, no doubt, consequent on the recent heavy rains. Its fall pushed the down slow line towards the down fast and the latter was also put out of alignment, and it was on the latter line that the train was travelling.

ALL the railway directors who were Members of the House of Commons in the late Parliament have been re-elected, except that Mr. E. B. Fielden, the deputy chairman, L.M.S., and Mr. E. G. Cadogan (L.N.E.) have retired from Parliament. The railway directors in the new Parliament include: Mr. L. S. Amery (S.R.), Sir Alan G. Anderson (L.M.S.), Major J. J. Astor (G.W.), Sir Charles Barrie (L.N.E.), Lord Burghley (L.N.E.), Major Carver (L.N.E.), Sir George Courthope (S.R.), Major Sir Ralph Glyn (L.M.S.), Sir Robert Horne (chairman, G.W.), and Mr. H. Macmillan (G.W.). The railwaymen had only one representative—Mr. W. Dobbie—in the last Parliament. That gentleman has been re-elected and has been joined by Mr. J. Henderson. Mr. J. H. Thomas, who has been re-elected, is an old railway servant and was the general secretary of the National Union of Railwaymen. The Minister of Transport, Mr. L. Hore-Belisha, and the Parliamentary Secretary to the Ministry, Captain A. U. M. Hudson, have been re-elected.

UNDER the Great Western's share in the scheme for new works that the railways are to undertake with Government assistance, partly for the relief of unemployment, the Plymouth, North-road, enlarged station will allow the Millbay and Mutley stations in Plymouth to be closed; Millbay Docks station will remain in use for Ocean traffic. The work to be done at Exeter, St. David's, is very interesting. At present the lines from the Southern Company's Exeter Central Station descend to and join the Great Western lines at the west end of St. David's Station, and Southern trains pass through and use that station and run on the G.W. metals to Cowley Junction, about 2 miles farther on. Under the new work the Southern lines will be built on the level from the Central Station and be carried across the G.W. lines and then enter a high-level St. David's Station, and thence over two new independent lines to Cowley Junction. The extended areas where automatic train control is to be used are the lines from Plymouth to Penzance, from Cardiff to Fishguard, and from Wolverhampton to Chester.

THE proposed electrification of the L.N.E.R. main line between Manchester and Sheffield is of exceptional interest for many reasons. The main engineering feature in its length of 41 miles is Woodhead tunnel, just over 3 miles long, the western portal of which is 19 miles from Manchester. The summit of the line is at the eastern end of that tunnel, and it is approached from Sheffield by 19½ miles of mostly 1 in 130. From Manchester the gradients vary, but at some points are more severe than those on the eastern side of the tunnel. From Guide Bridge—5 miles out of Manchester—there are stretches of 1 in 143, 1 in 122, 1 in 100, 1 in 117, and, finally, 1 in 201 for the 3 miles through the tunnel. It will therefore be an admirable testing ground for contrasting steam operation with electric traction on two long stretches, each of about 20 miles, on gradients that are as severe as any to be found in this country outside such exceptional ones as Shap, Beattock, and The Lickey. One of the greatest advantages lies in the fact that there is a dense traffic of fast and slow passenger and fast and slow freight trains which will provide the first opportunity in this country for testing electrification in general traffic and over a severe road. There will be no complications from other companies' trains, except that the L.M.S. runs passenger trains for Victoria Station, Manchester, and freight trains for Ancoats for about 1 mile between Ashburys and Ardwick. There is also a big residential area on the south side of Manchester where electrification would be justified, and this could be combined with the Altrincham line services of which the L.N.E.R. is joint owner.

Miscellanea.

IT is proposed by the London Passenger Transport Board to run trollybus services in Central London if the necessary permission of Parliament can be obtained. The proposed new service will connect the existing tramcar termini at the Holborn end of Gray's Inn-road and Farringdon-road.

AN article in the *Automobile Engineer* describes a method of descaling heat-treated parts by an electro-chemical process. The process employs a simple electro-chemical bath, where the work forms the cathode, so that the scale is lifted from the surface by the hydrogen gas generated by electrolysis of the water in the descaling solution, whilst at the same time a thin protective metal coating is deposited on the clean metal from which the scale has been removed. The film formed protects the exposed parts during subsequent continuation of the descaling process to remove scale from the remote or recessed parts.

WITH a view to lowering the cost of road building and surfacing, the Alabama State Highway Department has established a testing laboratory to examine the possibility of utilising local materials. The laboratory in the last few months has saved various counties and the State several thousands of dollars in road building costs. Extensive search is made in the vicinity of each project to discover what materials—sand, gravel, shale, and rock—may be available in those localities. Gravel and other materials are being placed on some new roads at a cost of 50 cents per cubic yard, where it had previously cost between 4 and 6 dollars per cubic yard.

THE official returns rendered to the Electricity Commissioners show that 1650 million units of electricity were generated by authorised undertakers in Great Britain during the month of October, 1935, as compared with the revised figure of 1434 million units in the corresponding month of 1934, representing an increase of 216 million units, or 15·1 per cent. The number of working days in the month (*i.e.*, excluding Sundays) was twenty-seven, the same as last year. During the first ten months of 1935 up to the end of October the total amount of electricity generated by authorised undertakers was 13,877 million units, as compared with the revised figure of 12,309 million units for the corresponding period of 1934, representing an increase of 1568 million units, or 12·7 per cent.

THE results of experiments carried out in France show that aluminium powder mixed in certain paints gives strong rust-resisting properties. One of the successful formulæ for such paints was pitch 62·5 per cent., aluminium powder 12·5 per cent., and diluent 25 per cent., the best results being obtained when two coatings were applied. Experiments showed that the surfaces protected in this way were not only more resistant, but also more durable than when protected by red lead paints, while the fluidity of the pitch paints and the opacity due to the aluminium combine to give a covering power two to three times that of red lead paints. In addition to its use for the prevention of atmospheric corrosion, this aluminium paint has been used for the protection of boiler walls in a large power station.

THE second local section of the Institute of Physics to be formed in this country was inaugurated at a meeting held at the University of Birmingham on Friday, November 15th last. Professor S. W. J. Smith was elected Chairman, and Dr. J. H. Mitchell, local hon. secretary. Professor J. A. Crowther, hon. secretary of the Institute, explained the aims of the Institute, and pointed out that the object of the section was to provide opportunity to bring together physicists, particularly the many now employed in the industries of the Midlands, and others interested in the subject and its applications. The inaugural lecture was given by Dr. J. D. Cockcroft, of the Cavendish Laboratory, Cambridge, who took as his subject "Recent Work on Nuclear Transmutations." It is proposed to hold the meetings of this new section in Rugby and Leicester, and possibly other towns in the Midlands during the session.

A RECENT paper by Mr. C. E. Fairburn before the Institute of Transport dealt with the application of heavy oil engines to railway transport. He said that electrified suburban services demand heavy horse-power, often as much as 15 h.p. per ton at starting to give the necessary acceleration, but the diversity factor on an extensive system is such that all the trains can be operated by a relatively small power plant and distribution system, whereas with heavy oil units each train has to be engined for the largest demand. Furthermore, the engine and transmission take up space and add weight to the train, and this weight has itself to be accelerated, increasing the horse-power required as compared with a corresponding straight electric train. The extra plant required, engine, transmission, housing accommodation for the engine and drive, and larger motors is such that there would not appear to be any field for oil engine traction on heavy suburban services, but it is found that the lighter the traffic the smaller is the advantage of electric traction, owing to the lesser spread of its equipment costs.

A NEW preparation for the protection of aluminium, which at the same time provides a base for paint, lacquer, or enamel finishes, has been placed on the market by Pyrene, Ltd. Known as "Pylumin," and supplied in powder form, the compound is a mixture of several chemicals which, when dissolved in boiling water, forms a solution and reacts quickly upon aluminium, converting the surface into a non-metallic film of complex basic oxides, which is highly resistant to corrosion. The surface is of a uniform grey to black, according to its constitution, and is velvety in texture. That it provides an adequate base for paints is due to its ability to exert capillary attraction. The process is effected in a heated tank, the size of which depends upon the rate and quantity of production required. Because of the short processing time, only three to ten minutes' immersion being required, the system is adaptable for conveyor methods, but for small production the work can be handled by baskets or racks in still tanks. After processing, the work is rinsed in hot water and dried. Degreasing of the parts is unnecessary, unless excessive oil or grease is present.

Air and Water.

THE tenth order secured by Wear shipbuilders within the last three weeks is a 9000-ton cargo steamer for the Bantham Steamship Company.

A COMMITTEE has been appointed by the French Government to prepare plans for the construction of a new naval base at Mers-el-Kebir, Algeria.

THE liners "Amsterdam," 8670 tons gross, and "Hessen," 8116 tons gross, have been sold to German buyers, and will be converted into whale oil factory ships.

WHILST being refuelled in Brindisi Harbour, the Imperial Airways flying boat "Sylvanus," working on the Brindisi-Alexandria route, caught fire and was totally destroyed.

WE are informed that the boilers of the new liner being built in Holland for the Holland-America Line are to be of the latest Yarrow water-tube type, and will be built in that country under Yarrow licence.

FLYING a Percival "Gull" machine with a "Gipsy" six-cylinder 200 h.p. engine, Mr. H. F. Broadbent has made a new solo flying record to Australia from England, having covered the distance in 6 days 21 h. 19 min.

AS part of its new £7,000,000 defence plan, the Dutch Government has ordered a new type of "Fokker" two-engined fighting machine. These new aeroplanes are said to be capable of a speed of 223 miles an hour, and can carry a crew of four and ten large bombs.

A REPORT states that the Belfast Harbour Commissioners have decided to obtain Parliamentary powers to construct an aerodrome on the site prepared by them on their estate at Sydenham. The site has water frontage and is suitable for both flying boats and aeroplanes.

THE L.N.E. Railway has approved of a scheme for the extension of the dock accommodation at Hull, the estimated cost for which is £700,000. The scheme provides for the extension of St. Andrew's Dock in a westerly direction, a new quay and slipways, and a new coaling plant.

A MOTOR tanker, built specially for the carriage of lubricating oils, has been ordered by the Anglo-American Oil Company, Ltd. The vessel, which will be capable of carrying twenty-seven grades of oil at one time, will have a deadweight tonnage of 10,200 and the tanks will have a capacity of some 2,500,000 gallons of oil.

A CONTRACT for the carriage of mails by air between Liverpool and Douglas, in the Isle of Man, has been awarded to British Airways, Ltd., by the Postmaster-General. The contract calls for one service daily each way, and it is expected that an average load of over 400 lb. of mail will be carried each journey.

THE statistics for Southampton Docks for October compare very favourably with the returns for the corresponding period in 1934, every phase of traffic showing an increase. The number of vessels inward numbered 245 as against 229, and outward 241 as compared with 218. Gross tonnage amounted to 1,492,930 tons inward, which was 17,309 tons less than in October, 1934; there was, however, an outward increase of 121,007 tons, which resulted from the total rising from 1,400,277 tons to 1,521,284 tons. The net tonnage showed an increase both inward and outward. The former total was 821,710 tons as compared with 813,200 tons in October last year, whilst outward the return was 822,687 tons as against 758,747 tons.

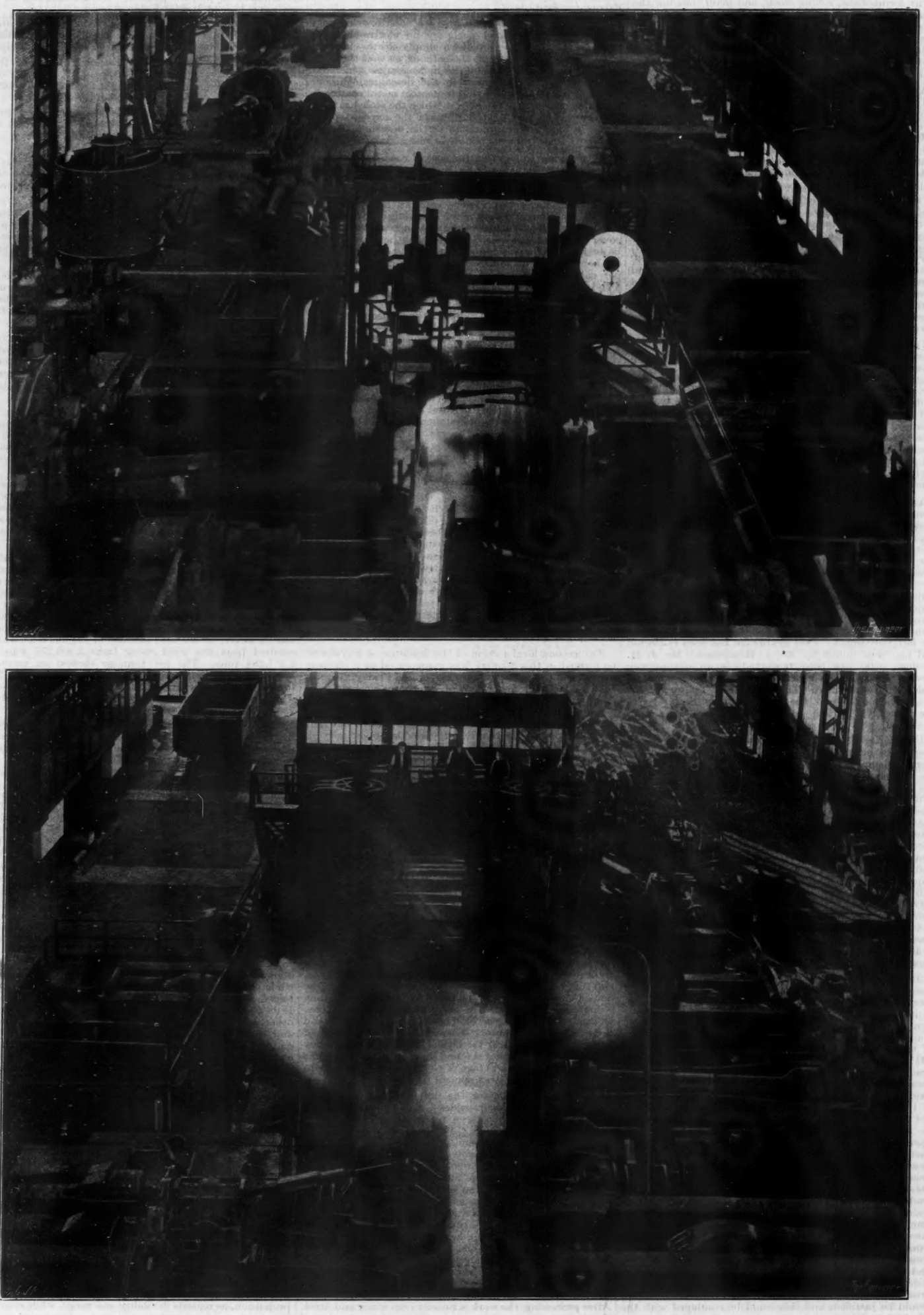
A NEW type of monoplane for civil or military purposes has been introduced in the Miles "Peregrine" twin-engined cabin machine. Wooden construction is employed and the wings are of the cantilever type, having two spars and a plywood covering which takes the drag and torsional stresses. The fuselage is a semi-monocoque structure, and the main cabin is unobstructed by shear members or bulkheads. This cabin is 12ft. long, 4ft. 6in. wide, and is 5ft. high. Up to six seats can be fitted in the rear, and there is a large space aft suitable for camera equipment, wireless, and/or drift and bomb sights. The engines are either two inverted six-cylinder in-line, air-cooled D.H. "Gipsy Six" 200 h.p., or two Napier "Javelin" 160 h.p., giving the machine a maximum speed of 188 m.p.h. and a cruising speed of 164 m.p.h.

IT is reported in Italy, says the correspondent of the *Journal of Commerce*, that the Lloyd Triestino is to build a motor liner of 20,000 tons gross and 24 knots speed for an express service, in conjunction with the "Conte Rosso" or "Conte Verde" re-engined for the purpose, from Genoa and Naples to Shanghai. The schedule allows for the voyage to be made in twenty-one days, while the service from Trieste to Shanghai will be maintained by two ships of 18,000 tons and 20 knots speed. It is also stated that the Lloyd Triestino is to order other motor vessels for service in the Mediterranean and Black Sea. They will have tourist accommodation and refrigerated space. The company has decided to establish shortly a new fortnightly express service between Trieste and Jaffa, covering the voyage from Piræus to Larnaca (Cyprus) in forty-eight hours, which will be a record time. A 10,000-ton vessel will be employed on this service.

AN oil-engine-propelled icebreaker and buoyage vessel which has been ordered by the Swedish Government is to be fitted with a magnetic coupling between the engine and propeller shaft. According to an extract from *Hansa* in *Shipbuilding and Shipping Record*, the magnetic coupling, which acts on the principle of the eddy current brake, will eliminate mechanical connection between the engine and propeller, thus reducing the risk of damage in ice and facilitating accurate manœuvring of the vessel. By increasing or decreasing the electrical excitation of the primary part of the coupling any desired degree of slip can be obtained from zero up to the full speed of the engine. Surplus electrical energy generated when running at low propeller speeds is available for other purposes, or can be stored in accumulators. It is claimed that the new system offers all the advantages of Diesel-electric propulsion, as regards flexibility and range, while employing simpler circuits and control gear. The engine must, however, be reversible.

CORBY IRON AND STEEL WORKS

(*For description see page 539.*)



FRONT AND BACK VIEWS OF BLOOMING MILL IN OPERATION

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TWO-PAGE SUPPLEMENT—THE CORBY IRON AND STEEL WORKS OF STEWARTS AND LLOYDS, LTD.

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A NEW NAVAL CONFERENCE.

A NAVAL Conference attended by delegates of the United Kingdom and the Dominions, the United States, Japan, France, and Italy, is to open in London on December 6th. It has been summoned in compliance with the Washington Treaty, which provided for the holding of a new conference within one year of that treaty being denounced by a signatory Power. As Japan announced last December her intention of withdrawing from the Washington compact, it became necessary to summon the forthcoming conference. In spite of the clouded political horizon in Europe, there are several reasons, other than the legal obligation, why it is desirable to hold a naval conference before the end of the year. The first and weightiest is the marked change which the international situation in respect of sea power has undergone since the London Treaty was signed in 1930. The British Government of that date was still firmly wedded to the principle of unilateral disarmament, and, as an act of faith, entered into one-sided commitments which, as is now almost universally acknowledged, have gravely impaired our capacity for naval defence. The consequences have proved to be what any student of human nature might have predicted. While this country deliberately slowed down its naval construction, other Powers proportionately increased the *tempo* of their building. Inevitably, therefore, the relative strength of the British Navy to-day is far below the level at which it stood six years ago, and recent events in the Mediterranean have provided a sharp, if salutary, reminder of that disturbing fact.

In these circumstances no Government worthy of the name could hesitate to restore our sea defences to a standard of strength and efficiency commensurate with security. Definite pledges to that effect have been given by the Prime Minister, and the country awaits their speedy fulfilment. But before proceeding to set our fleet in order it is vitally necessary to gain an insight into the naval intentions of foreign Powers. This country assuredly does not wish to build a single ton in excess of what is actually required, and it is particularly anxious not to become involved in an unrestricted building competition. That calamity may yet be averted by the impending conference. While it is too much to hope for a renewal of naval limitation on the existing system of ratios—which has, indeed, been repudiated by Japan and condemned by France—it ought not to be beyond the wit of statesmanship to devise some alternative formula which will satisfy legitimate aspirations without provoking ruinous competition. Such, at least, is the belief of the British Government. The British programme, as foreshadowed in well-informed quarters, aims at achieving both quantitative and qualitative limitation; that is to say, the restriction of each navy to a maximum aggregate of tonnage and a reduction in the size of individual ships. As regards the latter proposal, there seems at the moment little prospect of securing "cuts" in the Washington standards, of 35,000 tons for capital ships and 10,000 tons for cruisers. American naval opinion considers these dimensions to be the smallest consistent with the great steaming endurance which, in the absence of oversea bases, is held to be an essential feature of United States warships. Great Britain has repeatedly urged a reduction to 25,000 and 7000 tons respectively. It remains to be seen whether the conference will succeed in establishing new standards somewhere between the upper and lower limits. This is a matter of special interest to the taxpayer, for the difference in cost between a 25,000-ton ship and one of 35,000 tons is very substantial. Great Britain, it is authoritatively stated, will make a further effort to bring about the abolition of submarines, but nobody really expects the attempt to succeed, and most of the delegates will dismiss it as a pious gesture. Of more practical importance is the question of restricting the formidable submarine armadas which have sprung into existence abroad. In the 1935 Blue Book, "Return of Fleets," France is credited with no less than 111 submarines, Japan with 69, and Italy with 67. We know, also, that Germany has 28 submarines completed or building and is about to add to that number. This brings us to a second potent reason for reviewing the whole naval situation in consultation with other Powers. Germany's rearmament at sea was not envisaged when the London Treaty was signed, and it has completely upset the balance of power which the Treaty was intended to stabilise. Under the Anglo-German agreement negotiated last June Germany is conceded the right to build up to 35 per cent. of Britain's aggregate tonnage. Her current programme, which was announced a month later, shows that she has lost no time in exercising her newly-acquired right. A few years hence she will possess an entirely new fleet, consisting, not of "pocket editions," but of full-scale vessels in every category from battleships to submarines, all of which will be concentrated in the Baltic or the North Sea. In view of this unforeseen development it will be impossible for Great Britain to rest content with the very modest quota of strength to which she has up to now been restricted. Nor could she have done so even had there been no German naval revival. The quota in question was accepted six years ago on the express condition that other Powers should make proportionate reductions, especially in their cruiser and submarine programmes, as is distinctly stated in an Admiralty memorandum of July, 1930. As we have seen, however, those programmes have been largely increased instead of being reduced, and both the legal and moral basis of the London Treaty has in consequence ceased to exist. In spite of this fact the British Government has decided to abide by the Treaty until it expires at the end of next year, though in so doing the country incurs obvious risks. An important question to be considered by the conference is the resumption of capital ship construction. It is generally accepted that the "holiday" which has lasted since 1922 cannot be further prolonged. Already there are building or on order for Continental navies eight capital ships of 26,000 to 35,000 tons, to say nothing of the four German 10,000-ton "armoured ships" which mount a battleship's armament. The completion of these new units will emphasise the semi-obsolete character of the British battle fleet, which contains but three ships of post-Jutland design. In all likelihood, therefore, next year's Navy Estimates will provide for the laying down early in 1937 of one or more capital ships, the tonnage of which must be determined by the outcome of the impending conference. Another subject for debate is the differentiation of cruisers from torpedo craft. In Part III of the London Naval Treaty, which France did not ratify, flotilla leaders are restricted to 1850 tons and destroyers to 1500 tons, all vessels above 1850 tons automatically falling under the category of cruisers. France, however, has thirty-two vessels built and building of an average displacement of 2432 tons, notable for their heavy armament and great speed. She rates them as flotilla leaders, though by treaty classification they are cruisers. British leaders have hitherto been kept within a limit of 1475 tons and our largest destroyers displace 1375 tons. This marked discrepancy between the size and fighting power of British and foreign torpedo vessels cannot be allowed to continue. Leaving aside the big French leaders, we have nothing comparable with the Japanese 1700-ton destroyers, the Italian 1628-ton scouts, or the new German destroyers of 1625 tons. Nor is it only in torpedo craft that we have accepted standards of size and armament inferior to contemporary foreign designs. For years past we have been building cruisers of lighter tonnage and battery than their "opposite numbers" abroad. Even the German official publication, "Marine Rundschau," comments this month on the fact that "it is something new for Britain deliberately to keep far behind other Powers in the size of her men-of-war." This mistaken policy will, we trust, be reversed. Whatever limits the conference may impose on future ships, it should be our policy to build up to them. That will be the truest form of economy.

Meanwhile the Government has drawn up a programme of replacement, the details of which may become known in the course of the conference. They will, of course, be subject to modification should the conference lay down new rules for quantitative or qualitative limitation, but it may be taken as certain that from 1937 onwards the yearly quota of new construction, especially in the cruiser and destroyer categories, will be considerably larger than it has been at any period since the war. The programme is expected to cover a term of five years and may possibly be financed by a loan. Unfortunately, so far as cruisers are concerned, it cannot be put into operation until 1937, for up to the end of next year we remain bound by the provisions of the London Treaty. According to these, Great Britain is entitled to lay down in 1934, 1935, and 1936 only such cruiser tonnage as may be necessary to replace that of ships over age (62,000 tons), plus the tonnage of ships becoming over age in 1937, 1938, and 1939 (23,850 tons), a total of 85,850 tons. Of this amount, 58,850 tons have already been absorbed by the 1934 and 1935 programmes. Consequently there remain only 27,000 tons available for next year's cruiser programme, equivalent to three ships of the "Southampton" class. These figures, which are supplied to us by the Admiralty, emphasise once more the crippling effects of the London Treaty on the normal development of the British Navy.

Ebbw Vale.

EIGHT years ago the Ebbw Vale Steel Works closed down, with the exception of the sheet and coke oven plant, and have since remained one of the derelict undertakings of the country. Situated as they are in the heart of an area which suffered more than most districts from the slump, these great steel works have existed only as a monument to the fallibility of human endeavour in the face of economic pressure, and it had come to be regarded as almost a certainty that they would never again resume production. The news, therefore, that an offer to purchase the works with a view to reopening them had been made by Richard Thomas and Co., Ltd., was received with intense relief in a district which had suffered the full rigours of unemployment. That relief found expression in thanksgiving services in all places of worship. This must be regarded as a measure of the feelings aroused and as an indication of the modern attitude of the public towards industrial operations of the importance of the Ebbw Vale undertaking. No longer can they be considered as mere commercial ventures, for their capacity to provide employment has come to be looked upon as a first essential. It is difficult to say why these steel works, after a period of comparative prosperity, proved so complete a failure. Many views have been expressed on this point, but one obstacle generally admitted is that while the geographical situation was convenient for coal supplies, it was some distance from the Northamptonshire ore beds from which the raw material was drawn. The absence of a finishing department, except five sheet mills, must also have made them less fitted than most of the British steel works to

withstand the great depression. In a recent report the Commissioner for Special Areas expressed the opinion that the centre of gravity of the iron and steel industry was shifting, and that the dominant influence which will affect the future of the industry lies in the deposits of ore in Northamptonshire and Lincolnshire, and presumably the distance of consumers from that source of supply. By embarking upon the considerable outlay involved in the acquisition and modernisation of the Ebbw Vale Steel Works, Richard Thomas and Co., Ltd., would seem to be challenging this view.

From statements made by Sir John Beynon, the chairman of the Ebbw Vale Company, it seems likely that the terms offered by Richard Thomas and Co. will be accepted by the debenture holders and shareholders of the Ebbw Vale. In fact, the negotiations have reached such an advanced stage that it has been possible for the purchasers to announce that they are prepared to spend more than a million pounds upon rebuilding the works. Furnaces and mills are to be pulled down and replaced by modern plant, and one of the latest American continuous strip mills, capable of producing strip up to 72in. wide, which could be utilised for the manufacture either of sheets or tin-plates, is to be installed. The works have considerable resources, and the physical assets which will be taken over from the Ebbw Vale Company are neighbouring collieries as well as orefields in Northamptonshire. It is obvious that the Commissioner for Special Areas must have been greatly exercised by the fact that these works were lying idle in one of the most depressed districts in the country. For some time, it is understood negotiations were carried on with the Austin Motor Company, Ltd., in the hope that the works would be taken over for the production of sheets of the kind used by the motor industry. This would have brought into employment only part of the works, as the full requirements of the British motor car manufacturers are estimated to amount to 100,000 to 110,000 tons per annum. According to Sir William Firth, however, it would be necessary to produce 300,000 tons a year to make the Ebbw Vale works a successful commercial unit. In the end, the motor car manufacturers decided that the Ebbw Vale works were too large for their purpose, and the negotiations lapsed; but it has since been decided to form a company to manufacture sheets at Wolverhampton. There can be no doubt that it is better for the district that the Ebbw Vale works should pass into the hands of a successful and well-managed steel-making concern like Richard Thomas and Co. than that they should become the auxiliary plant of another industry. If the distressed areas are to be helped, new industries must be introduced, and it is difficult to see how this can be done without competing in some degree with existing businesses. The turning over of the Ebbw Vale works to the production of raw material for a single industry would have meant competition with the steel works which at present supply that material. Even the reopening of the works by Richard Thomas and Co. must introduce the competitive element, since it will be necessary to develop the manufacture of materials not hitherto made at Ebbw Vale. An announcement to this effect has been made by the chairman of Richard Thomas and Co., and has attracted much attention. The nature of the product has not been made public, and guesses have been hazarded, ranging from the establishment of a canning industry to the production of tin-plates for the manufacture of beer containers or fish-boxes. We are, however, able to state definitely that one project which is being seriously considered by Richard Thomas and Co. is the manufacture of cement, and possibly bricks. For some time, Continental and American steel works have utilised blast-furnace slag for the production of cement, and it is suggested that recent inventions may enable the material to be manufactured at a very economical figure. The fact that Sir William Firth, the chairman of Richard Thomas and Co., Ltd., has resigned his directorship in cement companies may be an indication of the importance attached by his company to this project.

For some years British steel makers have regarded the manufacture of steel at Ebbw Vale as commercially unprofitable, as a result of unavoidable economic causes. It may be that a great aid to the successful conduct of the works will be found in the careful development of by-products. For instance, it is estimated that cement could be made at the works and sold at a profit, and even if market conditions necessitated the realisation of the output at a very low price, it is calculated that it would result in a saving of 5s. to 8s. per ton upon the steel produced, as there would no longer be a dead loss upon the slag. The development of other by-products may be considered. It is, of course, obvious that the development of production on these lines would lead to competition with existing manufacturing interests, but in the case of a basic industry like steel it is impossible to exploit fully the by-product departments without clashing in some measure with established organisations. Science is continually finding processes for utilising materials previously regarded as waste products, and in no direction is this more noticeable than in the iron and steel industries, in which all initial heats are retained and gases once regarded as waste are used to effect substantial reductions in coal consumption. When, as in the case of the Ebbw Vale works, the development of this side of the business may go some way towards restoring prosperity to a depressed area, it would be unthinkable if the modern doctrine of the elimination of competition were allowed to stand in the way.

Literature.

Siphon Spillways. By A. H. Naylor, M.Sc., Assoc. M. Inst. C.E. London: Edward Arnold and Co. 1935. 8s. 6d.

In this small book of less than 100 pages the author provides an adequate summary of the principles governing the design of siphon spillways, some account of their use abroad, and a more detailed description of the largest siphons so far constructed in Great Britain, namely, those recently brought into service at the Laggan dam of the Lochaber water power scheme. Although in recent years increasing use has been made of siphon spillways abroad, only two large spillways of this description have been constructed up to the present in this country. Of these, the Laggan siphons probably represent the highest development of the system attempted anywhere. The other recent British example, of which the author also gives a description, is the siphon spillway at the Dunalastair dam of the Grampian Electric Supply Company.

The author has had the advantage of being engaged on both the design and the construction of the Laggan siphons, and is therefore in a position to write with authority on his subject. Although a good deal of information about siphon spillways may be found by searching technical journals and proceedings, particularly in foreign countries, no book devoted to the subject has yet appeared, so far as the author knows, either in this country or abroad, and references to such siphons in text-books on hydraulics are scanty. The application of the siphon to large spillways is a comparatively recent development. According to Mr. Naylor, the first siphon spillway appears to have been constructed in 1866 at Mittersheim, in Lorraine. It was not until 1904 that a siphon designed to dispense with an auxiliary priming device was built by Heyn, of Stettin, and about the same time Gregotti in Italy constructed large siphons of this type in reinforced concrete. In America siphon spillways appear to have been first used in 1909 for the Oswego locks on the New York State Barge Canal. Since then the principle has been widely applied in the United States and many installations have been constructed in Italy, Germany, France, Switzerland, and Norway. In Great Britain conditions favourable to the adoption of such spillways are rare, and that is probably the reason why large examples have not, until recently, been built in this country, where the flood rise above the crest level of a reservoir dam is usually too small to justify the use of any other type than the usual overflow or plain weir. It is in connection with dams built across narrow valleys or gorges, where the provision of a weir of adequate length is impracticable or difficult, that such a device as the siphon spillway comes into its own.

All mechanical weirs require constant attention and maintenance. The use of those which are automatic in action for flood discharge in connection with storage reservoir dams, where they may be called upon to operate at intervals of perhaps years, must involve an element of risk, even though it may be a small one. Culverts with sluice gates have the advantage of giving a high intensity of discharge of water, and, if necessary, a culvert can avail itself of the full head of the dam. But the safety of a dam should not depend upon a mechanism, the satisfactory functioning of which is subject to the risk of human error, a risk which is present in the case of all non-automatic weirs, culverts, and sluices. A siphon spillway, suitably designed, provides a discharge capacity approximately equivalent to that of a culvert functioning under a similar head, and at the same time is free from most of the objections attaching to the use of mechanical weirs and sluices for the rapid discharge of flood water at a dam. Mr. Naylor discusses at some length the relative advantages and disadvantages of the several systems, and, on the whole, succeeds in making out a good case for the siphon.

The catchment area above the Laggan dam is large, the mountain sides are steep, and the rainfall high. In these circumstances, a plain spillway the full length of the dam across the neck of the relatively narrow valley would have been insufficient to deal with the maximum flood, with the dam crest at the desired level, without risk of raising the flood water level at times above the permissible limit. The siphons at Laggan provide a concrete case illustrating the relative discharge capacity of the two types of spillway. That of a plain spillway with 2ft. depth of water running over the crest is approximately 10 cusecs per foot run of the weir. Each of the Laggan siphons, of which there are six, has a width of 6ft. 10in. and a throat depth of 3ft. The discharge capacity of each unit is 650 cusecs, or about 96 cusecs per foot of siphon width. The six siphons are arranged to prime and function at full discharge in three groups, two priming when the head of water over the crest of the dam is 6in., two with a rise of 1ft., and the remaining two when the head is 1ft. 3in.

It is obvious that serious consequences might follow upon any failure of siphon spillways to act as and when required, and for this reason there has been hitherto some disinclination to employ them for embankment dams. In well-designed siphons, such failure, in the author's opinion, need no longer be feared. In order to eliminate risk of failure to function, owing to either human or mechanical error, a siphon must be automatic in its action, and as free from mechanical devices as possible. In all siphons of early date priming is under manual control, and the air pump or ejector is the only device by means of which priming may be initiated at will with the water level below the crest; but the air pump is only suitable for use where manual control is desired. In some recent examples of large siphon spillways manual control has been eliminated, and the functioning of the siphons made completely automatic. The author gives details of the various means by which satisfactory automatic working can be secured, and a detailed description of the Laggan siphons which are representative of the latest developments in this respect.

For various reasons, which the author describes, the inlet mouths of the Laggan siphons are placed at a depth of 8ft. below crest level. Unless suitable provision were made the siphons would therefore continue in operation until the reservoir had been drawn down to the lip of the inlet cowl and a great volume of water would be wasted. The ideal arrangement is to "break" the siphons—that is, stop siphonic action—as soon as the water falls below the intended maximum storage level. This is most conveniently achieved by admitting air to the upper bend in sufficient quantity to destroy the partial vacuum. At Laggan automatic mechanical control of the admission of air to the siphons for the purpose of "breaking" has been provided. The simple automatic air valves which are installed for this purpose fulfill the fundamental condition of safety in that should anything get out of order the valve would close automatically, and thus allow the siphon again to prime. Both priming and breaking take place with a difference of water level of no more than 3in. The Laggan air valves represent, we believe, the first practical use of an automatic device to secure "breaking" of a siphon having a submerged inlet.

The author points out that fear of freezing has been one of the chief deterrents to the use of siphon spillways, but, according to him, "siphons have been constructed in many lands where the winters are more severe than in this country, and no case is known of their being blocked by ice. In extreme latitudes this might conceivably occur, but even there it is unlikely that siphons would be required to function during the duration of a frost. In general, severe overflow does not take place until a thaw has set in, . . . and it is rare for ice to form on deep lochs or reservoirs."

Mr. Naylor, it seems to us, establishes his case for the use of siphon spillways in suitable situations; he shows that if they are designed to act automatically without complex mechanical arrangements, and with their inlets and outlets suitably arranged to avoid obstruction by ice, they can be relied upon to function satisfactorily in all conditions.

There has been some doubt as to the certainty of priming taking place at the designed depth of overflow. This matter is dealt with by the author, and it seems to be clear that there is no reason to fear that priming will not take place with a rise of water level above the crest of a small fraction of the throat depth. In a suitably designed siphon the depth over the crest at which priming can be relied upon may be reduced to one-fifth of the throat depth or even less.

The book is well illustrated by diagrams and photographic views of the Laggan and Dunalastair

dams, some of which show siphons in action. It will be of value to all engineers who are called upon to consider the provision of adequate spillway discharge for reservoir dams.

Machines and Purchasing Power. By E. F. Nash. London: George Routledge and Sons, Ltd. 1935. Price 6s. net.

We open this review with a recommendation. It is that all engineers who are endeavouring to understand the varied panaceas for industrial ills which are now being pressed upon the world should read it. Mr. Nash is a critic and a destructive one. But his criticisms are carefully weighed and logically presented. If he cuts up Mr. Henderson's scheme and Major Douglas's scheme, he does it, not to butcher them, but carefully and lovingly, with a scalpel, explaining the facts that are revealed as he proceeds. Towards the end of the volume it becomes pretty clear that he believes industrial slumps may ultimately be traced to financial causes; but whilst he thinks the policy of banking the world over is mistaken, he rebuts the charge, not uncommonly heard, that all bankers are villains. This attitude towards the subjects of his criticism characterises the whole volume. The author has the patience of the investigator of physical truths. If there are errors he does not call the perpetrators fools or rogues, but indicates the mistakes with detached logic. His treatment is as impersonal as if the panaceas had been ground out of a machine.

Broadly speaking, Mr. Nash concerns himself principally with Mr. Henderson and Major Douglas, but has a word to say on Technocracy and a convincing chapter on the small influence, if any, which machines have upon the creation of unemployment. His remaining chapters, one at the beginning and two at the end of the volume, deal with the question of banks and banking. The first is an introduction to what follows; the others, as already indicated, examine the influence of banking systems on industrial cycles.

It is, obviously, quite impossible to give in a review even a fair outline of the arguments with which our author counters the assertions of Mr. Henderson and Major Douglas. To the former he devotes only one short chapter, whilst Social Credit occupies about one-quarter of the book. As so many others have done, he attacks the A+B theorem, "the chief article of the Social Credit faith." After examining it in detail he observes: "Only one conclusion of positive value can be held to have emerged from this discussion. We may draw from it a useful warning as to the use of terms. When we compare 'costs' and purchasing power we must be careful to take 'costs' in the only sense relevant to our purpose as signifying the costs of the final product of industry. . . . There is a dangerous ambiguity in Major Douglas's statement that 'all payments' (*i.e.*, both 'A' and 'B') 'go into prices.' If 'prices' means 'prices recoverable from the public' and if 'all payments' means all the 'A' and 'B' costs of all businesses, the statement is not true. If, on the other hand, it refers to the 'A' and 'B' costs of a firm producing consumable goods—*e.g.*, a bakery—it is true; but in that case it is not true that the public's purchasing power is equal to 'A,' for 'A' now means the 'A' costs of the baker, whereas the public receives purchasing power at the same time from the 'A' costs of every other firm in the industry."

After dissecting Major Douglas's premises Mr. Nash devotes a chapter to Social Credit, which concludes with the following words: "Social Credit is simply another name for continuous and progressive inflation. As the foundation for a reformed monetary system it is a fantastic absurdity." Major Douglas and his followers, we believe, deny that Social Credit would lead to inflation. For ourselves we have never been able to see how that result could be avoided. May we hope that many of the engineers who are attracted by Social Credit will read this chapter, at least, in Mr. Nash's book. The Douglasites may say that inflation does not matter, in which case they are past praying for, but in the face of the arguments put forward by Mr. Nash they will find it difficult to deny that progressive inflation must follow from the operation of the scheme.

We have said enough, we hope, to induce those who, without prejudice, are anxious to weigh up the merits of schemes for modifying the financial systems of the world to read this book. We need only add that they will find no difficulty in doing so, for it is easily written and there is nothing in it that calls for a special training in economics.

BOOKS RECEIVED.

The Chemistry of Rubber. By H. Freundlich. London: Methuen and Co., Ltd., 36, Essex-street, W.C.2. Price 2s. 6d. net.

Road Aggregates: Their Uses and Testing. By B. H. Knight, D.Sc. London: Ed. Arnold and Co., 41, Maddox-street, W.1. Price 21s. net.

Training in Industry. Edited by R. W. Ferguson, B.Sc. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, W.C.2. Price 6s. net.

Principles of Mechanism. Second edition. By P. Dyson. London: Oxford University Press, Amen House, Warwick-square, E.C.4. Price 12s. net.

Garcke's Manual of Electrical Undertakings and Directory of Officials, 1935–36. London; Electrical Press, Ltd., 13–16, Fisher-street, W.C.1. Price 37s. 6d. net.

Commercial Motor Transport Exhibition.

No. III.

(Continued from page 520, November 15th.)

The Yorkshire Patent Steam Wagon Company.

The Yorkshire Patent Steam Wagon Company, a branch of Deightons Patent Flue and Tube Company, Ltd., of Hunslet, Leeds, which has been constructing oil-engined vehicles for three years, was represented by two vehicles of its maximum capacity class, which is built in sizes of 12, 19, and 22 tons gross loaded weight.

The four-wheeler vehicle illustrated in Fig. 27 is fitted with three-way hydraulic tipping gear, and is designed to carry a net load of 7 tons. It is fitted with a 4.H.W. Dorman-Ricardo engine, a four-speed gear-box, and a worm-driven rear axle. It has a 10ft. 5in. wheel base with a 12ft. body, and in the form exhibited it has been specially designed for getting heavy loads into congested spaces. This maximum-capacity four-wheeler is also made in two other sizes, with either 15ft. or 17ft. bodies. They are of the flat-platform type, and used for goods haulage. The Gardner 4 L W engine can also be supplied with the vehicle as an alternative engine.

Fig. 27—7-Ton Pay Load Oil Engine-Driven Lorry—Yorkshire

The eight-wheeler "Yorkshire-Diesel" vehicle shown in Fig. 28 was exhibited for the first time, and is built to take the heaviest load which can be imposed upon it legally. The vehicle is shown in the form of chassis and cab only, but if it is fitted with a flat-platform body it weighs 7 tons in working order, and can carry a net load on the body of 15 tons. It is equipped with a 6 L W Gardner engine, a five-speed non-unit construction gear-box, and a double-drive rear axle with three differentials, the transmission forming a special equipment for maximum capacity, long-distance work.

Fig. 28—15-Ton Pay Load Eight-Wheeler Lorry—Yorkshire

The rigid six-wheel Yorkshire vehicle, designed to carry 13 tons net load, was not exhibited at Olympia.

The English Electric Company.

A 50-seater double-deck trollybus of the all-metal welded type was one of the exhibits of the English Electric Company, of Stafford. It seats twenty-six passengers on the upper deck and twenty-four in the lower saloon, which is tastefully decorated and adequately ventilated. Compressed air brakes act on all four wheels, and a mechanical brake on the rear wheels. An 80 h.p. compound-wound motor drives the vehicle through needle roller universal joints, which transmit the power to the differential in the back axle. A foot-operated master controller gives a wide range of speed by cutting out the resistance in series with the motor in successive stages. Additional speed variation is then obtained by gradually weakening the shunt field. When the foot pedal operating the master controller is released the shunt field is gradually strengthened, thus causing the motor to act as a generator and return current to the line; in other words, to give regenerative braking. Further release of the foot pedal connects resistance across the motor, which therefore continues to produce a braking effect until the vehicle is brought almost to a standstill. If the regenerative circuit should be interrupted by a trolly dewirement or by a feeder braker opening, the rheostatic brake is automatically brought into action.

A single unit motor generator set supplies current at 24 volts for the lighting system, which has a 48 ampère-hour lead acid battery. The vehicle is specially insulated to ensure that there is no possibility of passengers receiving shocks and the equipment was subjected to a high-pressure test of 2500 volts for one minute. Other vehicles shown by the English Electric Company were a 48-seater double-deck omnibus mounted on a Leyland Titan chassis and a 31-seater single-deck saloon coach mounted on an Albion Valkyrie chassis.

Crossley Motors, Ltd.

The trollybus chassis shown in Fig. 29 was exhibited by Crossley Motors, Ltd., of Manchester. It conforms in every way with modern practice, is provided with regenerative and rheostatic braking equipment radio interference suppression coils, and an air brake with separate brake cylinders for each hub. A single trollybus motor made by the Metropolitan-Vickers Electrical Company is mounted in the centre of the chassis. Regenerative control, with differential

electric braking, is obtained by Metrovick control equipment, which provides for battery operation of the vehicle if required. One pedal serves for accelerating and retarding, but when the speed has been reduced to 3 or 4 miles per hour the mechanical brake is applied to hold the vehicle when it comes to rest. When starting from rest the first six control notches cut out the series resistance. The following five notches weaken the field, and the last notch shunts a diverter across the series field. On the return movement of the pedal the shunt field is strengthened, thereby causing the motor to regenerate, and the degree of retardation increases as the shunt field is built up to the point where the full shunt field strength is attained.

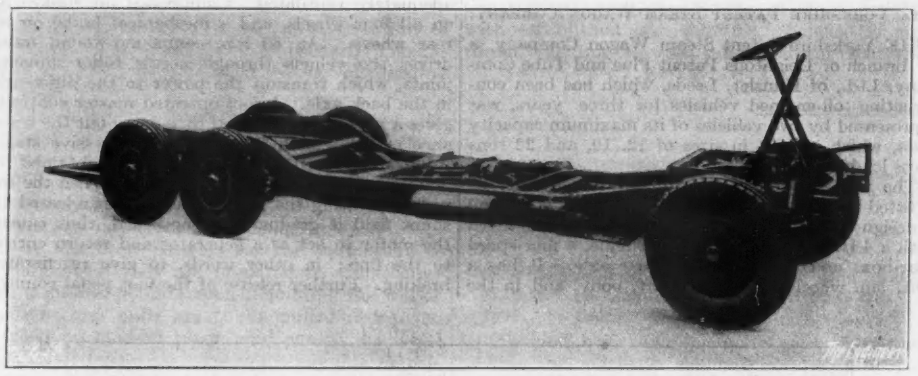


FIG. 29—TROLLYBUS CHASSIS—CROSSLEY

Effective regeneration ceases at a speed of about 12 miles per hour, when further backward movement sets up rheostatic braking, which is effective down to practically zero speed. To prevent premature application of the rheostatic brake at the expense of regenerative braking, the change over to the former takes place automatically when full use has been made of regenerative braking. Application of the rheostatic brake following regeneration or motoring takes place without jerk. The rheostatic braking torque is limited to the same value as that obtained on the strongest regenerative notch and dangerous overloading of the transmission gear is therefore avoided. To return power after rheostatic braking, it is merely necessary to depress the pedal in the normal manner. Protection against over-voltage is obtained by a relay which when this occurs automatically establishes the rheostatic braking connections an disconnects the motor from the line.

The main contactors are of the electro-magnetic type, with magnetic blow-outs and renewable arc chutes, and the operating coils are energised with current from the trolley. Shunt contactors differ from the main contactors mainly in that they are smaller. The scissors type master controller is situated under the driver's seat. Its contact bar is returned to the "off" position by a spring, and as the contacts are composed of silver they do not require cleaning.

A short tubular shaft transmits the power from the motor through an insulated coupling to the middle axle with couplings of the needle roller bearing type at each end. The slide due to axle movement is made in a splined sleeve at the forward end of the shaft, and the resultant end thrust is taken on a large diameter ball thrust bearing mounted in the end casing of the motor, thus relieving the armature of load. Another short shaft of similar design conveys the drive from the middle axle (in which a third differential is mounted) to the rear axle. Space will only allow us to add that a two-cylinder air compressor bolted directly to the casing of the motor which drives it supplies air to the reservoir for the Westinghouse air brakes, separate brake cylinders being provided, as stated, for each hub. The hand brake operates on the rear axles only and on the same brake shoes as the air brake.

THE STEEL BARREL COMPANY, LTD.

A typical modern tank vehicle is that illustrated in Fig. 30. It was shown on the stand of the Steel Barrel Company, Ltd., of Phœnix Wharf, Uxbridge, Middlesex. It is built to carry milk and has a designed capacity of 1400 gallons, and is of the elliptical, single-department type, built in stainless steel and mounted on an Albion M 55 chassis with a 5 L W Gardner oil engine. The tank is 15ft. 5in. long on the flat, giving an overall length of 16ft. 2in., with an elliptical section 5ft. 3in. wide and 3ft. 6in. deep. It is made of 10 gauge stainless steel, and is dull polished inside, with a descaled finish outside. All the seams are electrically welded and are ground flush and polished after assembly, the ends being hydraulically pressed to shape.

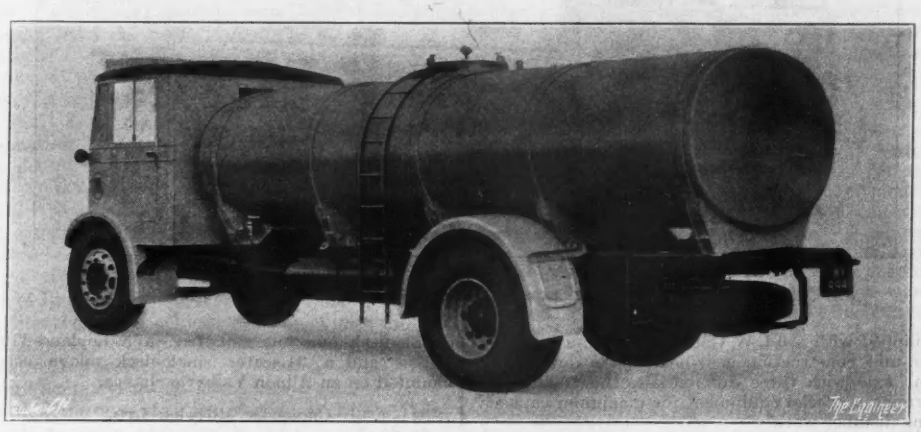


FIG. 30—MILK TANK ON ALBION CHASSIS—STEEL BARREL

The whole body is lagged with "Alfol" insulation to a depth of 1½in., and is covered with aluminium sheeting to ensure that the temperature of the internal container does not rise or fall more than 5 deg. Fah. above or below that of the liquid contents of the tank. The aluminium sheeting is supported away from the tank surface by means of a hardwood framing shaped to the tank and secured to brackets welded to the tank, this framing being arranged so that solid support is provided in way of each holding down strap in order to ensure secure fixing. An 18in. diameter manhole, having a hinged cover, and four hinged tightening down clamps is fitted. The cover carries a 1in. air vent cock, whilst to allow the tank to be unloaded under pressure and also to prevent a vacuum being created, a pressure-relief valve and a vacuum-release valve are fitted. The contents are discharged through a 2in. bright tinned locking type gun-metal cock, with a drip cap, which is at the front end of the tank, whilst close by the manhole is the usual ladder for gaining access to the manhole and fittings. At the back there is a small platform to carry three 17in. diameter churns containing cream. Alternatively, if the platform is not required, the tank capacity can be increased to 1450 or 1500 gallons. The tank is mounted on the chassis through rubber packing by means of five box-section steel bearers, and 4in. wide straps secure the tank to the bearers, which are in turn clamped to the chassis frame by means of high-tensile stirrup bolts and lock nuts.

THE BRUSH ELECTRICAL ENGINEERING COMPANY, LTD.

Among the exhibits of the Brush Electrical Engineering Company, Ltd., of Loughborough, is an all-metal trollybus body—Fig. 31—built in accordance with the company's patented sectional assembly system, evolved to ensure maximum strength and durability and interchangeability of any component. The skeleton framework is built up from 40-ton high-tensile lipped channel steel. All parts are bolted together with steel bolts. Frame joints are made rigid by the insertion of blocks of aluminium alloy to ensure the solidity of each joint, to prevent the crushing or distortion of any particular section, and to secure the full bearing value of all bolts. The exterior panels of both decks are composed of sheet aluminium screwed to hard wood packings inserted in the steel framing, the panel joints being covered with aluminium strips. Seating accommodation is provided for twenty-four passengers in the lower saloon and twenty-seven in the upper saloon.

FIG. 31—ALL-METAL TROLLYBUS—BRUSH ELECTRICAL

Other Brush exhibits are a single-deck 28-seater coach body on a Leyland "Tiger" chassis built for the Hants and Dorset Motor Services, Ltd., for the "Royal Blue Luxury Service," a single-deck 36-seater luxury coach body mounted on a Maudslay chassis, and a single-deck semi-luxury coach body mounted on a Daimler chassis. The two latter exhibits are to be seen on the stands of the Maudslay Motor Company, Ltd., and the Daimler Company, Ltd., respectively.

HENSCHEL UND SOHN, A.G.

A noteworthy foreign exhibit was that of Henschel und Sohn, A.G., of Cassel, which firm is represented in this country by Gossell and Son, Ltd., of 110, Cannon-street, London, E.C.4. The Henschel vehicles on view were representative of the special lorries which have been designed to meet the requirements of foreign customers and have already given satisfactory results in service. They included four chassis, a complete lorry for 4-ton pay load, with a 65 b.h.p., four-cylinder Henschel-Lanova engine; a bus chassis of similar design; a mountain-type lorry, and a 5½-ton lorry chassis representative of the heavy lorry types which can be equipped with either a

specially low gear or a super gear as required. A view of this chassis is reproduced in Fig. 32 herewith. In Fig. 34 we illustrate the rear axle assembly of the Henschel cross-country type chassis, which is driven by two overhead worms. It may be pointed out that the cross members of the frame are not welded together, but are riveted and screwed on. This practice has, we learned, given good results in actual service, as in case of accidents any twisted parts can be easily removed and readjusted. Perhaps the most interesting exhibit on the Henschel stand was the six-cylinder Henschel-Lanova engine—see Fig. 33—which has a designed output of 175 b.h.p. at 1500 r.p.m. The cylinder bore is 125 mm. with a stroke of 160 mm. Another engine was shown in section and illustrated the patented air cell principle of combustion which has been developed jointly by the Henschel company in collaboration with the Lanova A.G., of Munich. The shape of the main combustion space is not unlike a figure eight, and there is a double air cell arranged horizontally in the cylinder head directly opposite the injection valve. The Lanova principle gives, it is claimed, a progressive combustion with a comparatively low compression pressure. In order to facilitate starting the engine from cold the main part of the air cell can be cut off from the front part near the combustion space by turning a double-coned spindle with an outside hand wheel. When this passage is closed a higher compression pressure is obtained which facilitates starting. Attention may be called to the combined filter and oil cooler, which is placed close behind the fan, and is furnished with cooling fins. Attention may be called to the clean lines of the engine, which has a monobloc cylinder casing of nickel-iron alloy. There is an aluminium sump and the cylinder heads are cast in pairs. On the side of the engine shown there is the dynamo and the cooling water pump, while two 24-volt starters are mounted at the fly-wheel end. The Bosch fuel pump and injection system is employed with, however, a new fitting termed the Henschel torque equaliser. While in the majority of cases a constant maximum torque is looked upon as desirable, the Henschel firm looks upon a torque which increases as the engine revolutions decrease as an advantageous factor in engine performance. This results, it is claimed, in low-speed pulling power and better top gear performance with less engine wear. The Henschel automatic torque equaliser consists essentially of a throttling device in the fuel delivery pipes leading to the injectors, which causes the fuel pressure behind it to increase as the fuel flow increases with higher revolutions. The relief or throttle valve is connected to the fuel supply system and is placed just above the delivery valve on the fuel pump. It is designed to by-pass a quantity of fuel proportional to the pressure behind the valve, with the result that as the engine speed falls the pressure behind the valve falls, and with it the amount by-passed falls, giving a rise in the amount of fuel injected into the cylinder at low engine speeds. The valves referred to were made by Bosch to Henschel designs. Another interesting feature shown on the Olympia engine was the use of spiral heating coils arranged in the air inlet passage between the air filter manifold and the inlet valves. When in operation the spirals are kept at red heat by the battery current. This system has been developed by the Henschel company in collaboration with the Bosch Company, and by its means an increase of air temperature up to, say, 20 deg. Cent., can be obtained with, we are informed, a moderate battery current. This auxiliary starting device is only used for low-temperature conditions of, say, 5 deg. Cent., down to 15 deg. Cent. below zero, and in this range it is stated to be most satisfactory.

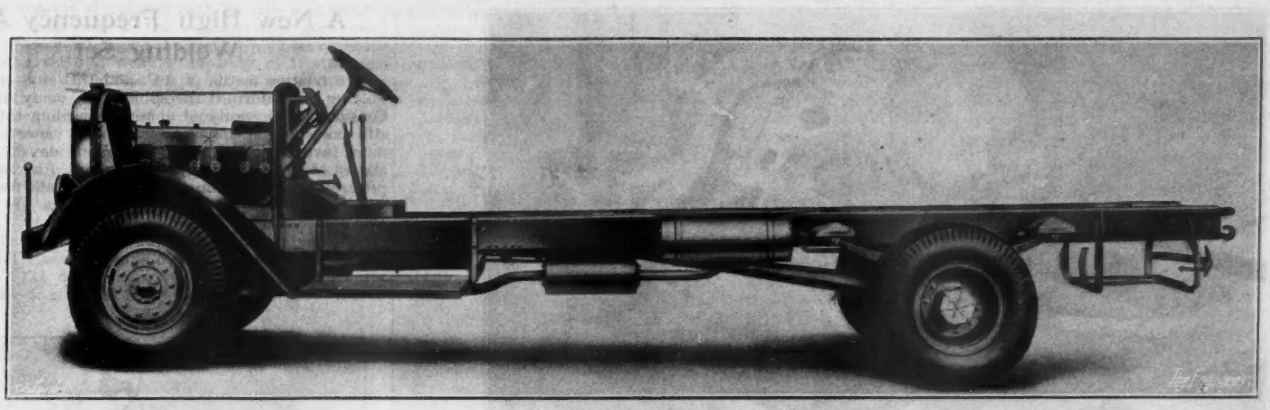


FIG. 32—HEAVY LORRY CHASSIS—HENSCHEL

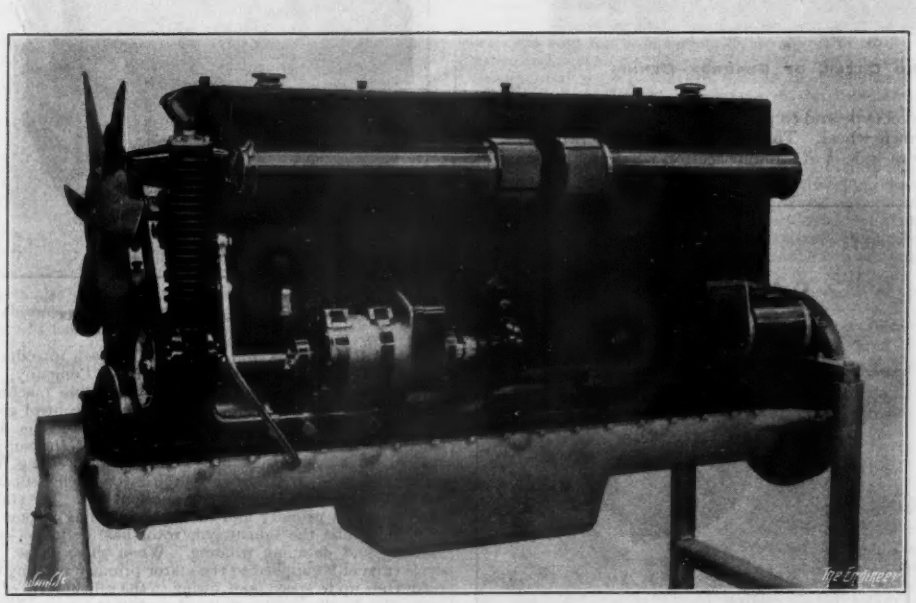


FIG. 33—SIX-CYLINDER 175 B.H.P. HENSCHEL-LANOVA OIL ENGINE

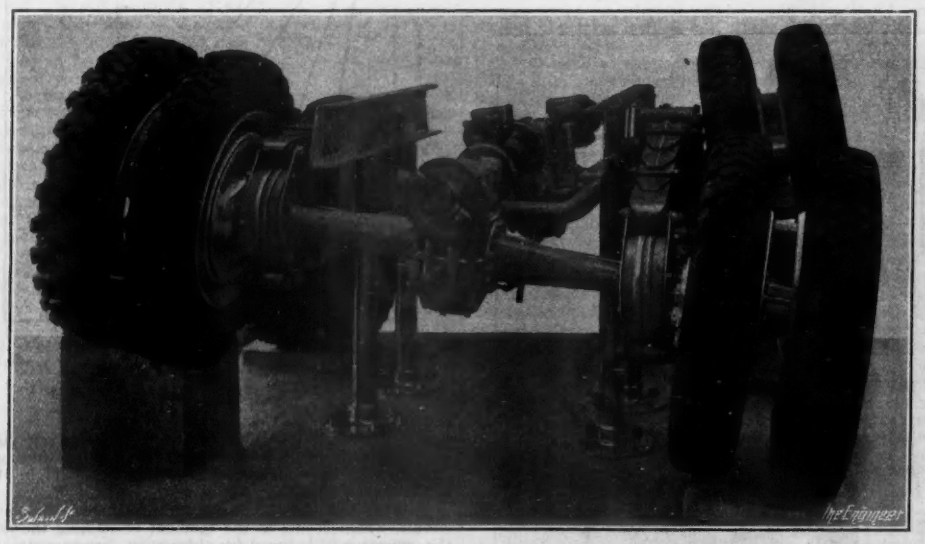


FIG. 34—REAR AXLE ASSEMBLY OF CROSS COUNTRY VEHICLE—HENSCHEL

DENNIS BROS., LTD.

The most important exhibit to be seen on the stand of Dennis Bros., Ltd., of Guildford, was the new Dennis "Lancet II" chassis, which has been designed to carry from thirty-two to forty-two passengers and to give exceptional body space. Without exceeding the legal limit of overall length of 27ft. 6in., a body space of 24ft. has been obtained. The frame has a depth of 8½in. and in the bay occupied by the gear-box there are two diagonal girders of welded box section, which make a very strong cross-braced structure. Details of this part of the chassis are shown in Fig. 36. The forward part of the chassis is also of interest, in that the forward member which carries the radiator and the front of the engine is bolted to the dumb-irons and is thus readily detachable, allowing the complete engine, clutch, and gear-box unit to be withdrawn from the front of the vehicle without disturbing the bodywork. The radiator is also new in design. The chassis has an overall length of 26ft. 10½in., an overall width of 7ft. 5in., and a wheel base of 17ft. 5in. The height from the ground of the laden frame is about 27in., with a clearance forward of the rear axle of 12½in. and 8½in. under the axle. The approximate turning circle is 62ft.

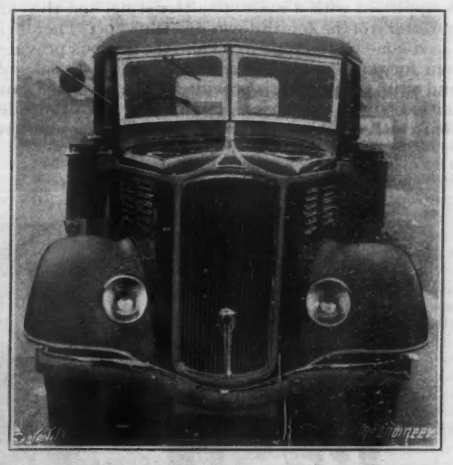


FIG. 35—4-TON LORRY—DENNIS

Either of two engines, the Dennis petrol or Dennis-Lanova oil engine, can be supplied, the chassis weight being about 7¼ cwt. in either case. Fig. 37 gives a view of the Dennis-Lanova compression-ignition engine with the clutch and gear-box, the latter having four forward speeds and a reverse. The engine is of the four-cylinder type, working on the airless injection principle with the Lanova type head, designed to utilise a relatively low compression pressure. The cylinders have a bore of 117·47 mm. with a stroke of 150 mm., giving a designed output up to 82 b.h.p. A feature of the engine is the use of diagonally split big ends, which greatly facilitate removal for examination. As our illustration clearly shows, the fuel pump, exhauster, and dynamo are neatly arranged on the near side of the unit, the electric starter being fitted on the off side. The corresponding Dennis petrol engine of the "Big 4" type has a bore and stroke of 120 mm. by 150 mm., with a designed output of 90 b.h.p.

Another Dennis vehicle of special design was the new light 4-ton chassis, a front view of which is reproduced in Fig. 35. It has been designed to deal with pay loads of 4 tons and not to exceed the unladen weight of 50 cwt. The power unit is a Dennis petrol engine with four cylinders, having a bore of 100 mm. and a stroke of 120 mm., with a designed output of 120 b.h.p. at 2250 r.p.m. It is furnished with forced feed lubrication and the oil is filtered and cooled in an external ribbed radiator. Coil ignition is employed with a magneto alternating, and the carburetter is of the Zenith down-draught type. The fabric faced cone clutch runs in oil and the gearbox provides four forward speeds and a reverse. A power take-off and a tire pump drive is provided. The power is transmitted to the rear axles by a divided open propeller shaft with a rubber mounted centre bearing and new type flexible joints. The rear axle is of the vertical banjo type with spiral gears giving a 6·43 : 1 standard ratio. As Fig. 38 shows, the differential assembly is offset to allow for large differential gears of the bevel type and to permit inclusion of a deeper toothed crown wheel. The rear axle is full floating and the front axle is of circular section where it is required to resist braking stresses. The chassis has a wheel base of 14ft. 6in., with an overall length of 21ft. 7⅛in. and a width of 6ft. 9$\frac{15}{16}$in. The height of the frame from the ground when laden is 2ft. 3½in., the turning circle 54ft., and the maximum gross weight of the vehicle 7 tons 10 cwt.

(To be continued.)

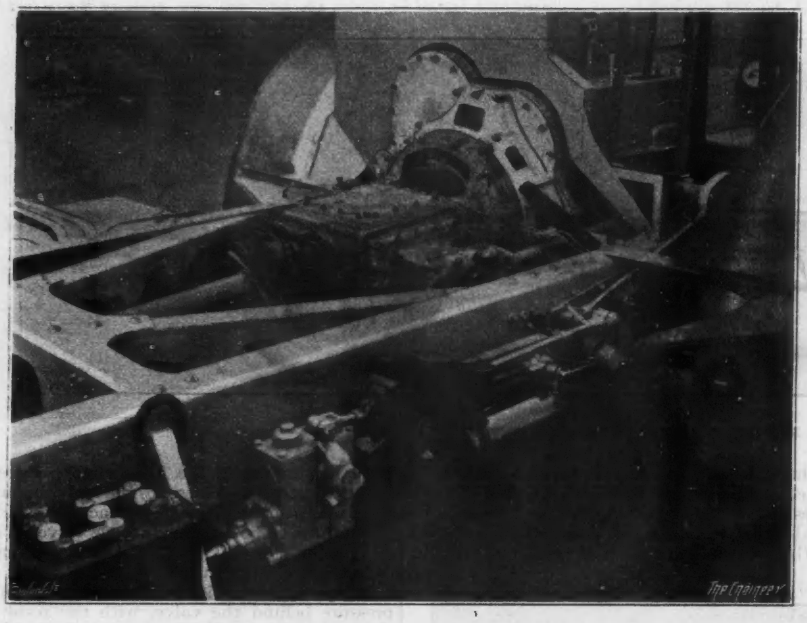


FIG. 36—CROSS-BRACING OF FRAME AND DETAIL OF GEARBOX—DENNIS

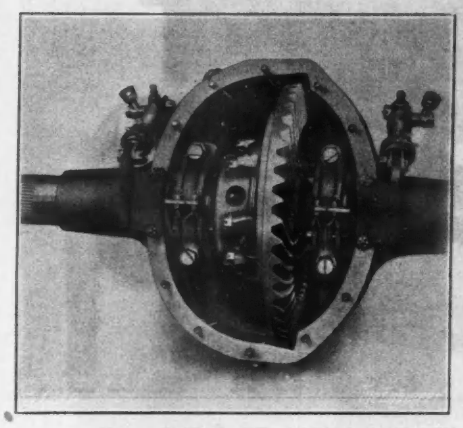


FIG. 38—FINAL DRIVE OF 4-TON VEHICLE—DENNIS

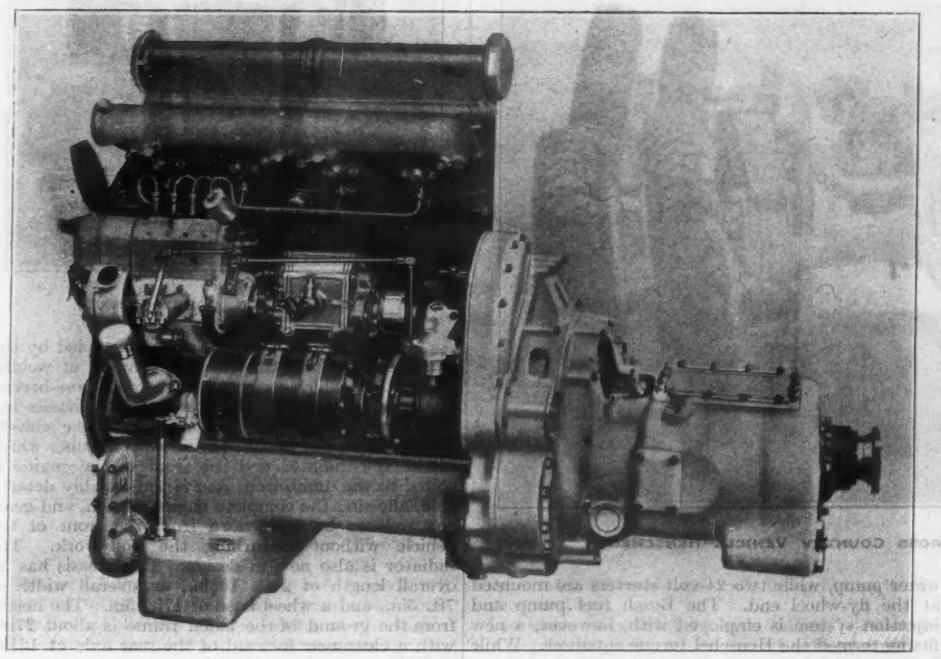


FIG. 37—DENNIS-LANOVA FOUR-CYLINDER 82 B.H.P. ENGINE WITH CLUTCH AND GEAR-BOX

A New High Frequency Arc Welding Set.

THE relative merits of A.C. and D.C. for electric arc welding have formed the subject of many discussions. Considerable diversity of opinion regarding the question still exists, but A.C. now appears to be viewed in a much more favourable light than in bygone days. For some classes of work, however, D.C. is deemed by many to be preferable. The welding of thin plates calls for very low values of welding current and absolute arc stability. Experience shows that high-frequency A.C. facilitates smooth and easy operation, and enables almost any kind of electrode to be used with equal success. The troublesome magnetic effects that occur with D.C. are eliminated. A new thin plate welding set—Fig. 1—designed to deliver A.C. at 150 cycles, has therefore been introduced by the Metropolitan-Vickers Electrical Company, of Trafford Park, Manchester. It is a portable machine, complete with starter and all the necessary control gear. Whilst it draws three-phase current from the mains, and thus does not tend to upset the balance of the supply system, it delivers single-phase current for welding, the conversion from the former to the latter being effected without the use of slip rings or a commutator. The stator carries both a primary and secondary winding in one set of slots, whilst the salient pole rotor has a squirrel-cage starting and damping winding. When three-phase, 50-cycle current is supplied to the stator primary winding the rotor runs up to speed, and, owing to the salient form of its iron core, finally pulls into synchronism the squirrel-cage winding then operating merely as a damping winding. By suitable arrangement of the two sets of stator windings, the rotor is made to induce a 150-cycle E.M.F. in the secondary winding.

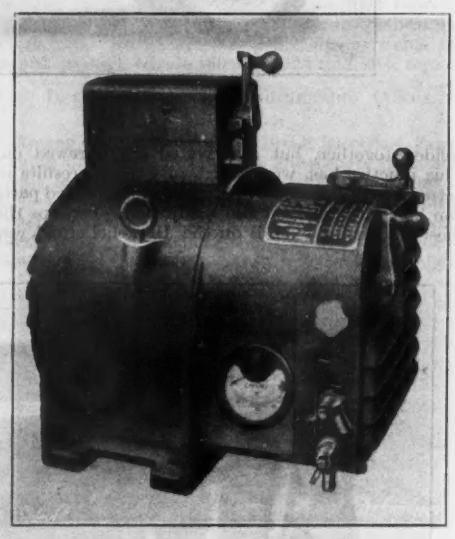


FIG. 1—THIN PLATE WELDING SET

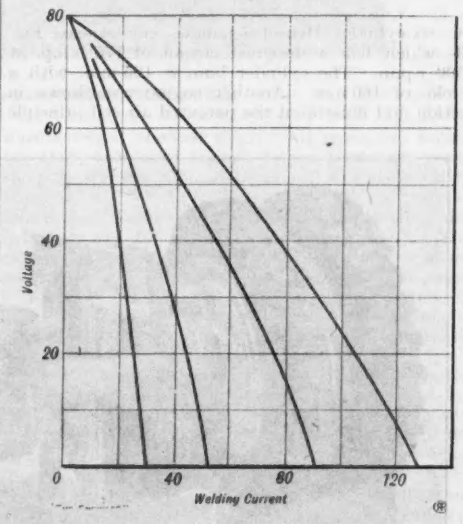


FIG. 2—GENERATOR CHARACTERISTICS

To limit the output current at the time of the short circuit, which occurs at the moment of striking the arc, the generator is designed for a drooping characteristic, as shown by the curves, Fig. 2, the internal reactance drop of the machine giving the required value of short-circuit current.

With the small currents needed for welding thin plates, fine control of the output current is essential. Hence the design of the control gear called for special attention. With its aid any current value between the maximum and minimum values of the range of the set can be obtained. It takes the form of a variable reactor connected in one

of the output leads and gives coarse and fine variations of reactance, and consequently of the current output. This reactor consists of a small two-pole stator and a rotor with two salient poles. The coils forming the winding may be connected in series, series-parallel, or parallel by means of a drum controller, Fig. 3, which gives four output ranges, and thus provides the coarse variations. In three of these ranges the reactor is included with its coils connected in accordance with one of the arrangements mentioned, whilst for the fourth range the reactor is short-circuited, thus making the full welding capacity of the machine available. Five variations in the output are obtained by adjusting the position of the rotor. Rotation through 90 deg. varies the air gap of the reactor from a maximum to a minimum, with a corresponding alteration in the value of the reactance. The rotor is turned by a handle on its shaft, and a pointer fixed to the handle indicates on a set of welding scales, each calibrated for use with a

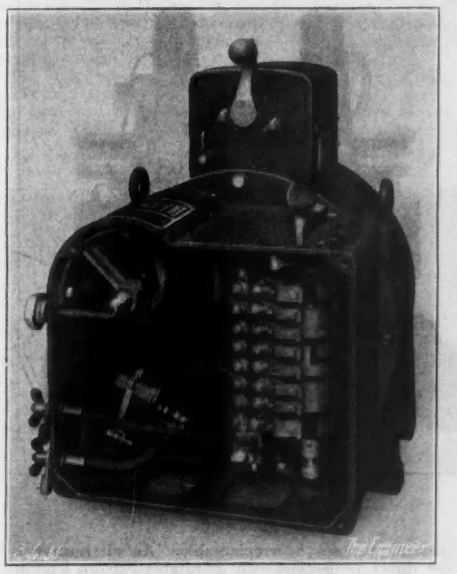


FIG. 3—DRUM CONTROLLER

particular position of the drum controller. By means of a clamping screw operated by an external knob, the rotor may be locked in any desired position.

This control gear thus provides the welder with an infinite number of steps between the maximum and minimum currents of the set, a feature of considerable value in connection with overhead work, and when welding vertical seams. A built-in ammeter enables the operator to keep a check on the current he is using. A small star-delta starter controls the machine on the driving side, and it is said that a short circuit on the secondary terminals during the starting period will in no way damage the windings.

It will be perceived that all the characteristic curves are steep and cut the 25-volt point at a large angle, which means that for small changes in arc length the output voltage alters so as to maintain the arc with only a small change in the value of welding current. This facilitates smooth operation, even on awkward work, which makes changes of arc length almost unavoidable. The effect of the variable reactor is to reduce the final short-circuit current obtainable without altering the open circuit voltage and the steepest characteristic is thereby obtained on the lowest current setting, where, owing to the already enfeebled state of the arc, stability is of greatest importance. The open circuit voltage of the machine is approximately 80, which, without in any way impairing the ease of striking the arc, promotes safe working, even in the most cramped positions. Records of output current and voltage show that at the point of removal of the short circuit the output voltage rises immediately to 66 volts, whilst in 7 cycles, or 0·05 second, it reaches the normal open-circuit value.

Another dynamic characteristic of interest is the ratio of the value of the current peak at the moment of short circuit to the steady welding value. Since it is of short duration, if the momentary surge of current be too great in magnitude, there will be a tendency for the electrode to fuse on to the work at the moment of striking the arc, and when welding light gauge material this leads to holes and plate burning. On the other hand, the current surge must be sufficient to cause the arc to strike. Experience shows that machines with a ratio of surge to steady current value of between 1·5 to 2 give the best compromise between the two extremes of "freezing" and the difficulty of striking. The ratio taken from oscillograms obtained with one of these new machines has been found to be approximately 2, and no difficulty is experienced in striking the arc.

Standardisation of Impulse Voltage Testing.

IT has long been recognised that transmission line systems are liable to be subjected to abnormal over-voltages arising principally from switching surges and natural lightning strokes. Over-voltages produced by switching surges have been found to be limited to about five times the normal operating voltage, whereas lightning strokes can produce over-voltages of a very much higher magnitude. The multi-stage impulse generator based on the marx circuit or on some modification of it has been invaluable as a means of providing very high impulse voltages for the study of insulation behaviour. The Klydonograph, or surge recorder, the cathode ray oscillograph, the surge-crest ammeter, and various other instruments have been developed for studying both natural and artificial lightning phenomena. Records have been taken of the electric field strength changes during thunderstorms, and of the rate of change of field strength. Data obtained by means of these devices have increased the store of knowledge concerning the mechanism of the lightning stroke, the behaviour of insulation when subjected to impulse voltages in the laboratory, or to lightning in the field, and the protection of transmission lines against trip-outs and of apparatus against damage.

It, therefore, appears that the time is almost ripe for the introduction of impulse voltage testing into the standard specifications, to ensure that electrical apparatus will withstand the enhanced and peculiar stresses due to surges. In a paper on "Standardisation of Impulse Voltage Testing," read by Dr. T. E. Allibone and Mr. F. R. Perry before the Institution of Electrical Engineers on Thursday, November 21st, standard impulse voltage routine and type tests are recommended for line insulators, bushings, switchgear, and transformers, and reasons are advanced for the choice of such tests. The repercussion of the introduction into national specifications of impulse voltage testing on the existing standardised power frequency tests is considered in detail, and recommendations are made for the elimination of some of those tests. To establish co-ordination between line and station apparatus under impulse voltages, a table is given showing the suggested impulse test voltages for station apparatus connected to normally insulated transmission lines, the proposed test values being based on the British Standard Specification for line insulators now widely in use.

It is shown that there are four main features of impulse voltage testing technique on which standardisation is desired—(*a*) the wave shape of impulse voltages to be used for testing purposes, defining clearly the methods of measurement and the tolerances permitted; (*b*) the measurement of the crest value of impulse voltages; (*c*) the precise conditions relating to spark-over, and (*d*) the precise conditions relating to puncture. These four features are dealt with. From the information available it is clear that the wide variety of the shapes of travelling waves and lightning discharges recorded in the field cannot be simulated in the laboratory, nor can any one laboratory impulse voltage test be relied upon to produce stresses within the object under test more severe than is likely to be produced by lightning. It has become the practice in testing laboratories to use for general purposes one impulse test voltage having a wave shape corresponding to about the mean of the records of travelling waves recorded on transmission lines, and to use one or two waves of other shapes of more extreme characteristics for special purposes. The exact choice of wave shape, the authors explain, is immaterial, but to facilitate the comparison of results obtained in different laboratories, agreement on the choice is highly desirable. Until recently no two laboratories worked with the same wave shapes or measured waves in the same manner, but international agreement is now being sought, and it is likely that methods of tests with impulse voltages and impulse voltage terminology will shortly be standardised.

SIXTY YEARS AGO.

IN our issue of November 19th, 1875, we published the second portion of Mr. John Bourne's reminiscences entitled "Recollections of Improvements which have been Made in the Steam Engine during the Last Half Century." In 1833 Bourne made the acquaintance of three remarkable men, David Napier, David Elder and John Wood, men whom he described as having, by their talents, judgment and enterprise, laid the foundations of the Clyde's subsequent high position in the domain of steam navigation. Round about 1855 Bourne induced Napier to set down on paper a few of the main incidents of his career. From this document, then still in his possession, Bourne gave an extract which has, we think, since passed into the history of steam navigation. Napier made the boiler and engine castings for Bell's "Comet." The boiler, made at first in cast iron, gave considerable trouble and even when it was re-made in malleable iron success in getting it filled was attained only with the aid of a liberal supply of horse dung. About 1818 Napier began to build a steamer of his own, the celebrated little "Rob Roy," and placed her, against the advice of many dismal prophets, on the Glasgow to Belfast route. On the first trip Napier was accompanied by Charles Macintosh, the chemist and inventor of waterproof cloth, who was fully convinced that everyone would be drowned. In spite of a gale, however, the outward and return trips were successfully accomplished. The "Rob Roy" was subsequently placed on the Dover-Calais route, thereby establishing steam connection between England and France for the first time and was eventually purchased by the French Government which re-christened her the "Henri Quatre," transforming her with the assistance of a priest and a little holy water from a Scots freebooter into a French king. Napier's engines, Bourne recorded, although ably designed were deficient in finish and workmanship. Nevertheless they were much more successful in practice than the better finished engines produced by Boulton and Watt, the continuous breaking down of which led for a time to a common belief that engine fractures were inevitable incidents of ocean steam navigation. Bourne claimed to have discovered the cause of the repeated failures of Boulton and Watt engines at sea. It lay, he said, not in the roughness of the sea, but in the fact that there was a defect in the design of the cylinder valve which made it possible for water from the condenser to flow into the cylinder and to be there imprisoned with the result that the engine was fractured by the action of the opposite cylinder. He overcame the trouble by inventing in 1834 a marine engine governor in which the balls were controlled not by gravity as on land but by springs. In a footnote to his article Bourne recorded the final history of the "Comet's" original engine. The vessel itself was run down by the steamer "Ayr" off Gourock in 1826 with the loss of a number of lives. The original engine had, however, previously been taken out and had been used to drive a small factory. In 1836 it was purchased by Mr. Atherton manager of Girdwood's works, who intended to preserve it as a curiosity. Subsequently Girdwood's works came into Bourne's possession and with them the "Comet's" engine. He repaired certain parts which had been broken and sent the engine to the Glasgow Polytechnic. That building was later burnt down and the engine was precipitated from the top storey to the bottom. After it had been dug out of the ruins the engine was purchased by Robert Napier and presented by him to the Patent Museum, South Kensington. John Robertson the original constructor of the engine—David Napier, it will have been noted, made only the castings for it—fitted up the engine in its final resting place.

American Engineering News.

Florida Ship Canal.

THE ancient and recurrent project of a ship canal across the peninsula of Florida, to shorten the route between the Atlantic and the Gulf of Mexico, and to avoid the dangerous reefs and islets—as well as the hurricane region—beyond the tip of the peninsula, is at last to be undertaken. The American Government has appropriated £1,000,000 for the commencement of the work, which is estimated to cost £30,000,000, and to require 570 million cubic yards of excavation. The total length will be nearly 200 miles, including deep-water channels at each end, and the widening of the St. John's River. For the canal proper the length will be about 100 miles with a bottom width of 250ft., and a water depth of 33ft. In rock, the side slopes will be 1½ to 1, and in earth 3 to 1. Five railway bridges will be of the vertical-lift type, while five road bridges will be fixed spans with 135ft. clearance above the water line. Weirs or spillway dams will be required at places where intercepted streams discharge into the canal. It will be a sea-level canal, but whether entrance locks will be necessary has not yet been decided. The deepest cutting will be about 120ft., of which 90ft. will be rock. Estimated quantities are 170 million cubic yards of rock, and 400 million cubic yards of earth, but the rock excavation includes 20 miles across a submarine ledge at the Gulf end of the canal. Tolls will be charged, sufficient to pay for maintenance, but no reasonable charge can provide for a return of the investment cost. A special difficulty, the result of which cannot be foreseen, is the effect of the canal upon the water supply of the district which it crosses. The present level of ground water is 40ft. to 50ft. above sea level, and it is claimed by some that the canal will lower this seriously, causing a great decrease in the supply from wells and springs, while at the same time there will be a serious infiltration of salt water to spoil the fresh water supplies for both domestic use and irrigation. The Government engineers, however, are of opinion that the effects upon quantity and quality of ground water will be slight and local.

American Railway Affairs.

After prolonged controversy, the United States Congress has passed an Act for regulation of highway traffic of motor trucks and motor coaches by the Federal Government. This regulation will be under the management of the Interstate Commerce Commission, which for years has regulated the railways. It will check the cut-throat competition to which the railways have long been subjected. But they are still over-regulated and unduly hampered, a condition which gave strong arguments to the highway traffic operators in their strenuous campaign to prevent Federal regulation of their operations. What is urgently needed is a reduction of railway regulation to a reasonable level, and the increase of highway regulation up to the same level. A new bureau with some 500 employees has been established for this new line of the Commission's activities; it will have a score of district offices throughout the country.—The Congress failed to pass a companion Bill providing for similar regulation of waterway transportation, which logically should have been passed. But it did pass a Bill to regulate railway's charges for their services at ports. Also a railway pension Bill designed to retire men at sixty-five years of age, or after thirty years' service, with annuities based on earnings and years of service. The purpose is to make room for the younger men.—As an indication of the serious condition of the railways, and its effect upon general prosperity, it appears that for the five "good" years, 1925–29, the railway purchases averaged £300,000 per year, while for the "depression" years, 1930–34, the average was only £130,000.—A recent Government report stresses the depletion of timber supplies and possible shortage of sleepers, omitting to consider that with the cessation of new construction and the general use of preservative processes, the average annual consumption of sleepers has dropped from 120,000,000 to about 75,000,000, and will probably drop to 60,000,000. Furthermore, sleepers are not generally cut from timber available for commercial purposes. While the report suggests further use of steel, concrete, and other "substitute" sleepers, the fact is that of the numerous designs which have been tried, none has been satisfactory or a serious competitor of treated wood sleepers in regard to length of life, annual cost or serviceability. Extended reports on the use of metal and concrete sleepers on railways in all parts of the world were issued by the United States Department of Agriculture in 1890 and 1894.

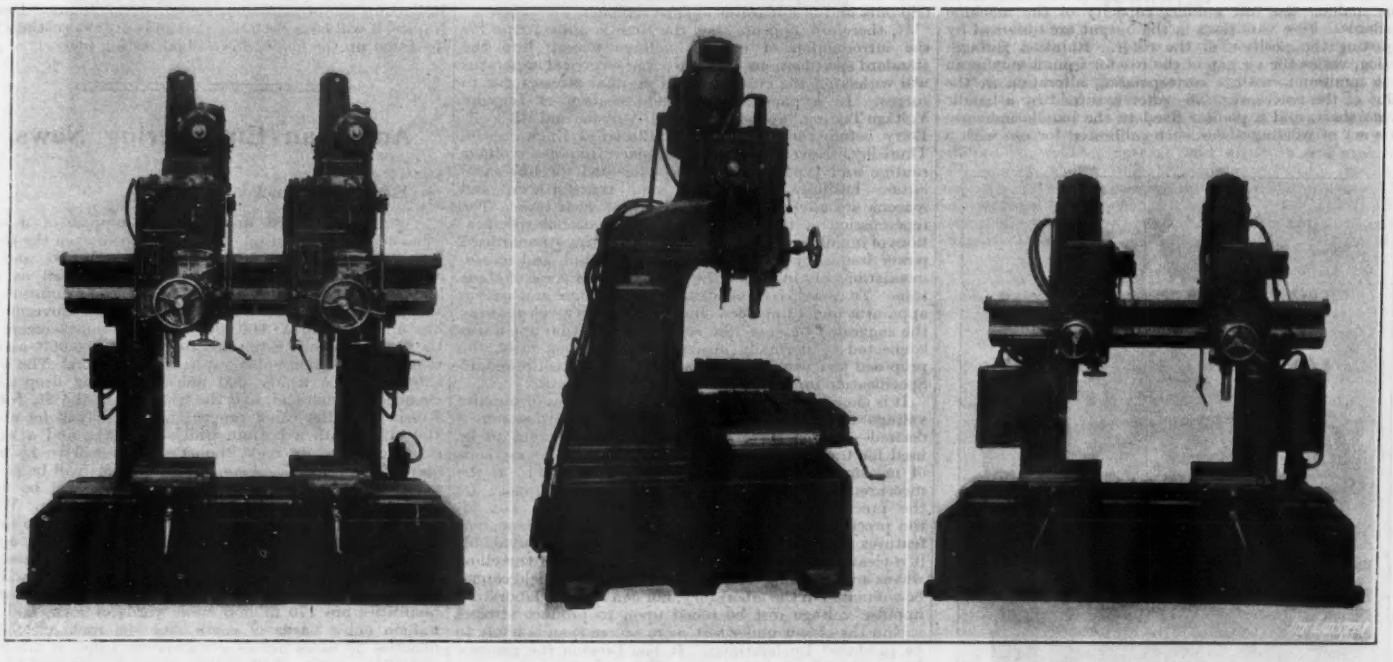
A FEATURE of the new works that the railway companies are about to undertake is the improvement of branch lines by their conversion from single to double line, in order to handle more efficiently holiday traffic to popular resorts on those lines. Such branches are the Barnstaple, Minehead, Newquay, and Porthcawl on the Great Western, and the Clacton and Felixstowe on the L.N.E.R.

Duplex Spindle Drilling Machines.

THE engravings on this page illustrate two duplex drilling machines, recently placed on the market by Kitchen and Wade, Ltd., of Halifax, and forming with other tools of the same class a range with driving spindles from 1¼in. to 8¼in. in diameter. The front views of machines with a capacity for 3in. in steel and of 1¾in. in steel respectively are shown. Particular attention should be given to the improved design of the cross rail, which provides a stronger framework, and to the sturdy design of the bed, which has troughs of ample size and a self-contained sump for the coolant. The compound tables are independent in action, so that work of entirely differing character can be machined under the two spindles simultaneously. The drill heads and saddles are also independent and each has its own self-contained motor drive.

The large tool has a spindle with a least diameter of 2½in. with six splines supported in large diameter hard steel sleeves over the full 18in. of feed. The spindle noses are bored No. 5 Morse taper. There are thirty-six speed changes between 800 and 8½ r.p.m. and eight rates of power feed from 36 to 150 cuts per inch. Observation of the engraving will show to what an efficient state the centralising of controls upon the saddle has been brought. Reverse can be engaged at any speed through a powerful friction clutch. Practically all shafts run in ball or roller bearings. There is an automatic trip for drilling to depth. The motions are, of course, interlocked to make the machine foolproof. The table below gives some details of the machine, together with the corresponding figures for the smaller machine also illustrated. The latter is generally similar in design and is the smallest of the range. It has spindles with a least diameter of 1¼in. and provides a length of feed of 12in. Eight speeds from 1500 to 80 r.p.m. are available and four rates of feed from 40 to 200 cuts per inch.

	3in. capacity in steel.	1¾in. capacity in steel.
Driving motors	7½ h.p.	3 h.p.
Maximum spindle centres	6ft.	6ft.
Minimum spindle centres	2ft.	2ft.
Maximum distance to table top	2ft.	1ft. 6in.
Working area of compound tables	18in. by 18in.	18in. by 18in.
In-and-out traverse	9in.	—
Distance spindles to columns	16in.	9in.
Floor space	9ft. by 4ft. 6in.	9ft. by 4ft. 6in.
Approximate net weight	6¾ tons	5½ tons



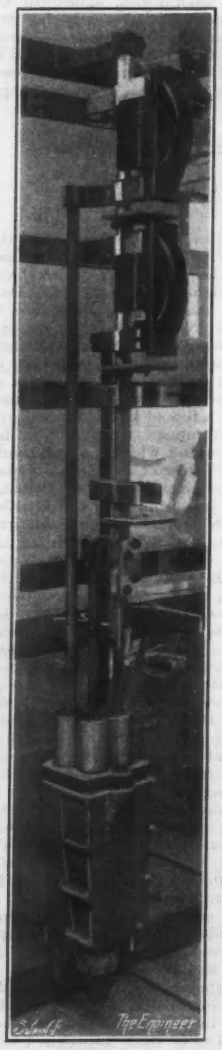
DUPLEX SPINDLE DRILLING MACHINES

A Universal Fuse Unit.

AT a recent fuse gear exhibition organised by the English Electric Company, of Stafford, the new universal fuse unit, shown in the accompanying illustration, was brought to our notice. Primarily intended for use in sub-stations and kiosks, it has been designed to facilitate cabling and to ensure that the phases are correctly connected with the least possible trouble. The present ratings are 300, 500, and 800 ampères, but a 150-ampère unit is being developed. All units can be fused up to their maximum rating and down to 2 ampères. Transformer, feeder, and special units are supplied. On the transformer type handle or hook-operated isolating links may be used, and in the latter case a quick break may be provided. Feeder units have standard shielded Home Office hand grip type fuse carriers, designed to take high rupturing capacity cartridge fuses, with a short circuit rating of 25,000 kVA.

Special units can be arranged for main current or transformer-operated metering equipment, including "tong test" metering.

Standard equipment for a three-phase four-wire unit consists of a Poxoline insulated steel rod with wrought iron fixing brackets at the top and bottom, three-fuse clip assemblies with connections to the bus-bars, and corresponding assemblies with outgoing cable sockets, a set of phase barriers, three shielded Home Office hand grip fuse carriers for high rupturing capacity cartridge fuses, a detachable neutral link, a set of outgoing cable connections, and a split cable dividing box and armour clamp. The units with back-connected bus-bars may be wall mounted. Additional units can be erected or dismantled without breaking the bus-bars or disturbing units on either side. Fuse boards can be built up on the unit principle, and be extended on existing framework. A separate cable box enables all jointing and connecting up to be carried out from the front of the board and the greatest possible facilities for inspection and maintenance are provided. Special arrangements have been made to facilitate cabling where space is limited. A set of insulated vertical copper rods are attached to the outgoing fuse contacts by means of clamped connector sockets and terminate at the lower end in a sweating socket within the dividing box. To avoid the necessity of phasing out the cable tails and to keep the cable box dimensions as small as possible consistent with accessibility and adequate clearances, the outgoing fuse contacts are arranged one above the other, the clamped right and left handed reversible connectors being in pairs.



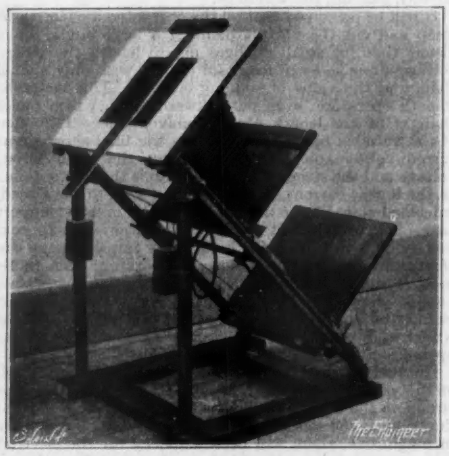
FUSE UNIT

With this arrangement it is possible for any phase to be connected to any particular rod, which has its position determined by the correct cable tail divided out in thebox. The arrangement ensures that irrespective of the phase rotation of the cable tails, the correct tail will be joined to its connector rod without crossing over. The dividing boxes are split on the vertical centre line. All the sweating sockets consist of heavy cylindrical brass ferrules tapped to take the screwed end of the connector rod which is locked in position by a lock nut, the lower end of the ferrule being bored out to suit the cable, and is provided with filling and escape holes for the solder. A moulded insulating spreader, having a ribbed section to increase the mechanical strength and the leakage path, is provided at the top of the box, and as a further precaution Poxoline seating sleeves fit snugly over the bosses of the spreader plate.

The accompanying illustration shows the universal fuse unit as erected in the makers' works.

Copying Machine.

ENGINEERS in works and engineers in consulting practice frequently find it necessary to reproduce parts of drawings or to reduce maps and plans to a smaller scale. For such purposes the pantagraph is often used and for certain purposes is irreplaceable. An alternative is to use direct projection with a suitable camera lens on to tracing paper. That is the method followed in the copying apparatus made by Casella and Co., of Fitzroy-square, London, W.1., and illustrated herewith. The apparatus consists of a steel framework supporting a drawing board at a convenient height and angle for a draughtsman standing. A large rectangular hole is cut in the centre of the board, and filled with a sheet of clear plate glass. Camera bellows are fixed between the underside of the board and a wooden screen which is counterweighted but can slide on the inclined members of the frame. The screen carries a suitable lens with fine focusing adjustment. A second drawing board, or object board, truly parallel to the first, is also mounted on the inclined members and can be slid along them. Quick adjustment for focus is given by sliding the screen with the lens. By suitable adjustment of the screen and the object board, any reduction of a map or plan attached to the object board is thrown upon tracing paper pinned over the plate glass, and is there copied direct by the draughtsman with the usual instruments. Scales are provided for indicating reduction.



COPYING MACHINE

The object board is lighted by four electric lamps arranged in reflecting hoods fixed right and left of the board.

We have had one of these "machines" in use in our drawing office for some time, and find no difficulty in making clear reproductions on it. It can also be used for sketching reasonably flat objects, such as small parts of machines.

MOVING complete buildings from one site to another is not uncommon now, and the latest job of this kind is reported in the *Engineering News-Record*. A 5000-ton reinforced concrete structure in New Orleans was recently shifted 160ft. on steel runners on a pile supported runway, the total moving time being under two hours, with an actual travelling time of twenty minutes.

High-Frequency Induction Furnaces.

Two high-frequency induction furnace installations for the production of high-quality rustless and heat-resisting steels have been put into service at the Wicker Works of Samuel Osborn and Co., Ltd., Sheffield. One is a 350-kW, ½-ton, fully automatic installation. The other is a ¼-ton, 150-kW, manually operated plant. Both have two furnaces with their own tilting gear. Those associated with the ½-ton equipment are tipped hydraulically, and those belonging to the ¼-ton, electrically. High-frequency motor generator sets for providing the power are housed in a sub-station immediately behind the ½-ton furnace platform. The high-frequency supply to the ¼-ton plant to which the following description applies can be changed from one furnace to the other by a totally enclosed switch in the left-hand section of the main control cubicle, to be seen in the centre of the first engraving. Interlocks prevent operation of the switch while it is carrying current.

The inductor coil of each furnace is held in a non-magnetic framework covered with "Sindanyo" plates. The furnace lining fits tightly against the inner face of the coil, which is composed of solid copper of special section with a cooling tube on the outer edge, the whole coil being heavily insulated and treated to present a solid wall to any metal that may penetrate the lining. Both furnaces are flush with the operating platform. The hydraulic tilting gear enables the speed of the tilting to be varied at will, and with the controller in the vertical position a furnace can be left at any desired angle indefinitely. Although the furnaces cannot be used simultaneously, the provision of two units with their tilting equipments gives important advantages, apart from continuity of service. One furnace may have a basic lining and the other an acid lining. A new lining may be put in one furnace while the other remains in service, thereby enabling a lining to be used for the maximum possible time without interrupting production.

High-frequency current at 1200 volts is supplied directly to the ½-ton furnace coils, which are devoid of voltage tapping arrangements. The maximum power supplied to each furnace of this ½-ton installation is 350 kW, which will melt most steels in fifty minutes. The high-frequency motor generator set in the sub-station some distance from these ½-ton furnaces is a high-speed, duct-ventilated machine, composed of a squirrel-cage motor and an inductor homopolar generator, mounted on a common bed-plate. D.C. is obtained for exciting the generator from a Westinghouse metal rectifier, which takes the place of the usual exciter and eliminates slip rings and brushes. The 440-volt motor takes its supply from a transformer fed on the primary side at 11 kV through a draw-out type oil switch. With the aid of tappings on the secondary side of the transformer and an automatic contactor starter, the motor is started without the use of an auto-transformer.

Although the 11-kV oil switch is closed by hand, it can be tripped from the furnace control cubicle. After passing through high rupturing capacity fuses near the generator, the high-frequency supply is conducted by cables to the main control cubicle, composed of three sections. One contains the change-over switch mentioned, another the high-frequency contactors and other high-frequency H.T. apparatus, whilst the third houses the L.T. gear for the control circuits. The automatic control system maintains the power factor on the high-frequency generator at or near unity, and a high overall efficiency is thereby secured. This control system is governed by a Kilovar instrument, consisting of a combined meter and relay, controlling the number of condensers in parallel with the furnace coils with the aid of contactors. The high-frequency voltage across the furnace coils is maintained at a constant value, set by the melter on the main rheostat. If necessary, the condenser contactors can be hand controlled.

Metering is done on the 50-cycle, 11,000-volt transformer circuit, and all losses are consequently taken into account. The instruments employed include an indicating wattmeter, a recording wattmeter, and a synchronous clock, which enable records of each melt to be kept. On the right-hand panel of the cubicle there are alarm lamps, which, on the occurrence of a fault, light and indicate where the trouble lies. Thermostats on the motor generator bearings give warning of excessive temperature. A relay associated with each furnace ensures that an adequate amount of water passes through the inductor coil.

As usual, the furnace condensers are divided into two banks. One is permanently connected to the furnace coil, while the other, which is divided into sections, is controlled by contactors, controlled, in turn, by the Kilovar instrument, which causes the contactors to switch portions of the condenser across the furnace coil at the full working voltage. Any condenser may be withdrawn from the rack without disturbing the others. Discharge resistances are connected to the condensers where necessary, and a test panel connected to the 50-cycle supply enables the capacity of various sections of the condenser bank to be checked when the plant is out of service. The condensers are of the high-frequency type, developed for furnace work by British Insulated Cables, Ltd., of Helsby.

The ¼-ton furnace installation, shown on the right, is very similar to that described. There are two furnaces, each with its own electric tilting gear, and an interlocked knife switch in the well of the furnace platform serves for changing over the current supply from one furnace to the other. Contacts on this switch change over the water relay circuits. The contactors which control the condensers for power factor correction are controlled by a six-point controller. The instruments consist of high-frequency voltmeter, and ammeters, and a centre zero Kilovár meter, giving reactive kVA readings, which indicate to the melter when a condenser contactor should be opened or closed.

The supply arrangements of the 150-kW, high-frequency motor generator set correspond with those of the 350-kW machine supplying the ½-ton furnaces, metering being carried out on the primary side of the transformer. The motor generator set is tap started, and its field current is supplied by a Westinghouse metal rectifier.

With the exception of the condensers, rectifiers, and hydraulic tilting gear (supplied by the Hydraulic Engineering Company, Ltd., of Chester), all the equipment described was manufactured at the Trafford Park Works of the Metropolitan-Vickers Electrical Company. The furnaces are employed for the production of the highest qualities of rustless and heat-resisting steels, such as "Evershyne," "Weldshine," and "Tropic"; also for high-quality alloy steels, including nickel-chrome air and oil-hardening steels, nickel steels, and special chrome-vanadium steels.

HALF-TON AND QUARTER-TON HIGH FREQUENCY INDUCTION FURNACE INSTALLATIONS

The Calculus of Plenty.

By SIR JOSIAH STAMP.

SIR JOSIAH STAMP delivered the Eleventh Annual Norman Lockyer Lecture to the British Science Guild at the Goldsmiths' Hall on November 13th, taking as his subject "The Calculus of Plenty." He said that of late years the term "plenty" still covered the glaring social maladjustment of things made, longed for, but unused, as dominant in Carlyle's "Past and Present." But gradually it had widened its content to mean much more, and in the last few years it had become, in its nebulous, over-suggestive and provocative complex, in a thousand headlines and titles, almost an intellectual menace. Articles and speeches on all sides pivoted and pirouetted on the phrase "poverty in the midst of plenty." Titles of books, themes of novels and philosophies now turned on plenty. In serious contexts the word spread new tentacles of connotation, away from the static maladjustment or muddle to a dynamic relationship. It took on qualities and extended beyond current potentiality to the to-morrows of science, as if realisable to-night.

Sir Josiah showed from many examples that the general references to "plenty" in its journalistic and platform use, and often in its more pretentious uses, covered a wide range of different circumstances to which very different economic principles, consequences and causes attached. If they were constantly lumped together in that way, there could be no clear thinking about the problems suggested, and we remained, not in the spirit of scientific inquiry into the nature of the impact of science upon society, but in rhetorical and unprofitable, though seemingly intelligent, discussion, without any rudder or compass. All the cases were covered by a main three-fold classification with various sub-heads. First, the plenty of physical or scientific potentiality; secondly, the plenty of unused or unmarketed production; thirdly, the plenty of unused capacity. The plenty of potentiality was mainly an engineer's and scientist's conception, and the idea was brought to its highest point in the technocracy boom, which had left its sinister trail of dreams and pseudo statistics over the whole field of thought and inquiry, a wreckage of irresponsible optimism which impeded smooth and orderly movement.

The current concept of Plenty, in its alliterative and therefore popularly almost causative association with poverty, was therefore fed from three main sources—the concept of things not hitherto made, but now capable of being made; the concept of things already made and standing unused; and the concept of things that had not, but could have, been made. Based upon that concept of Plenty, provoked by it, leading out of it, were many different social and economic issues. Conceptions of a planned society, of a more regulated society, of a self-integrated industrial order; theories of the economic cycle of unemployment, of under-consumption, of redistribution of incomes, of population, of control of investments, and particularly of social credit and reinforcements of purchasing power; concern about the lag of man's ethical and moral capacity compared with either the bounty of Providence or of the laboratory; the failure of science to integrate with society; the shortcomings of economists, as scientists or as moralists; "production for use and not for profit," and a host of allied contentious questions, all getting their impetus from Plenty.

Sir Josiah said his immediate purpose was to analyse *Plenty*, mainly in its quantitative aspects, because dependent from the separate elements of its causation must hang the diagnosis and the validity of all the reasoning which proceeded from the basic assumption of plenty. The problem was a summation of successive equal units or magnitudes with receding (*a*) time potentials, where, for example, an invention could only be brought into full use gradually; (*b*) cost potentials, where fuller utilisation of unused capacity involved greater proportionate expense for each unit; (*c*) demand potentials, where unused supplies could only be sold at lower prices.

He showed the many exaggerations of technocracy, and the general failure on the engineering and scientific side to reduce gross capacity to net actual capacity, and set out the following stages:—

(1) Allowance for operating margins, for breakdown, repairs, &c.
(2) Unco-ordinated surplus capacity, due to the "bottle-necks" of particular industries or types of skill.
(3) Seasonal surplus capacity.
(4) Practical demand potentiality, where one article is rising and another falling in popular desire for the same purchasing power or in competition (radios and pianos, gas and electric lighting).
(5) Capacity technically displaced, even on rising demand (out-of-date blast-furnaces, ships).
(6) Capacity displaced on stationary demand; invention displacement.
(7) Misplaced capacity (much plant due to excessive rationalism was of this type).
(8) Essential or minimum cyclical surpluses.
(9) Wasteful exploitation—of coal, oil, soil, forests—the present plenty of ultimate poverty.

Sir Josiah then gave in detail three types of measurement of actual capacity in practice in Britain, Germany, and the United States, to show how far these principles were recognised and measurable, and to obtain the basis of an ultimate recognised technique. He quoted the Brookings Institute conclusions that American industry had not been increasing its margin of unused capacity, 19 per cent. being a fair net estimate of the added production of which the plant was technically capable, and that there could be no material shortening of the working day if the quantity of goods and services the people aspired to consume were still to be produced.

Passing out of the scientific and engineering field, from the measurement of plenty on the supply side, into the economic side, Sir Josiah showed that measurements of the intensity of demand introduced a flood of light into the measuring of plenty, and that even with enhanced purchasing power some types of plenty would have a reality that others could never possess, and illustrated his argument from the case of boot and wheat production. The effect of slackening in the rate of increase of population was profound, for it created not a less but a more

urgent problem of social adjustment, because a given additional purchasing power of X distributed over a new population was quite different in quality and direction from purchasing power of X added to the demand of an existing population, and because increases in population had hitherto absorbed the effects (on production) of the changing direction of general demand due to fashion and invention.

He then dealt with gluts and destroyed produce, such as Brazilian coffee, where surpluses to the extent of two years' requirements had been burnt, and the wheat "overhang," which proved to be only 2·05 per cent. of six years' consumption—if the *per capita* consumption had not declined (not out of poverty, but out of changing demand in a higher standard of life) "the world would have used 710 million bushels more than it did, and would have been short of necessary working stocks." In dealing with prospective invention plenty, he put as a rough estimate that the lag between the plenty of the idea and the plenty of the fact was an average of one-half of the physical life of existing plant.

Passing to the subjective aspects of demand, 100 tons surplus of article X might mean at equivalent price and with similar consumption much more plenty than 100 tons of article Y, according to the elasticity of demand, and he suggested devices for estimating the units of plenty in each stock.

He said in conclusion that while alive to the importance of the great subjects which were superimposed upon the concept of plenty, he was pleading on this occasion only for a greater discrimination in treatment, and some beginning at measurement and common units of thought, to clarify our discussion and subsequent analysis. We could not repeat too often Lord Kelvin's dictum that we "never know much about anything until we have contrived to measure it."

Variable Speed A.C. Motors.

A VARIABLE-SPEED, polyphase, shunt commutator motor with an external regulator has been introduced by the British Thomson-Houston Company, of Rugby, to extend its range of A.C. machines capable of fine and economical speed regulation from 5 h.p. downwards. Although an additional regulator is necessary, the machine is less complicated than the B.T.H. motor described on page 234 of our issue of September 6th. The supply is connected to the stator instead of to the rotor, and control of the speed does not necessitate shifting the

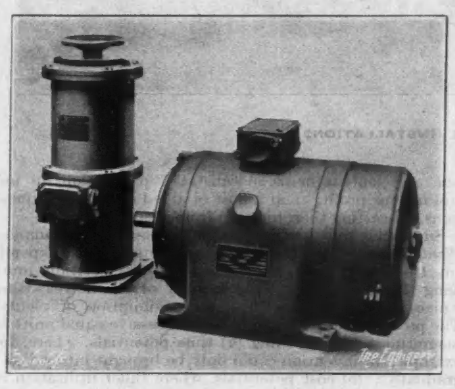


FIG. 1—3 H.P. MOTOR AND REGULATOR

brushes. Owing to the regulating gear (Fig. 1) being separate from the motor and to the supply being connected to the stator, the motor lends itself to total enclosure without an excessive reduction of output. It will be perceived from the diagram of connections—Fig. 2—that the commutator winding, which constitutes the secondary of the motor, is directly connected to the secondary of the regulator, whilst both the primary of the regulator and that of the motor are connected to the three-phase supply. Consisting as it does of an induction motor stator and D.C. type armature and brushes,

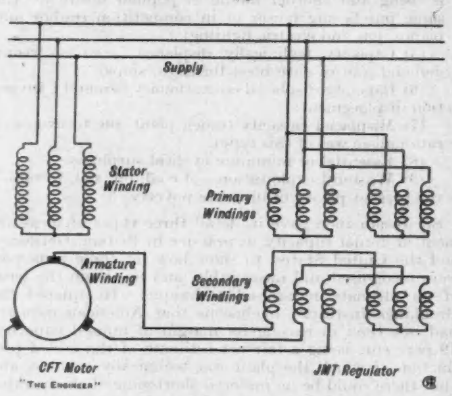


FIG. 2—MOTOR AND REGULATOR CONNECTIONS

the machine is simple compared with a motor that also involves the use of slip rings. By using a commutator on the rotor the voltage at the secondary terminals is made to have the same frequency as that of the supply, irrespective of the motor speed, which can therefore be varied above or below the synchronous value by applying a variable voltage of supply frequency to the secondary terminals. This variable voltage is obtained from an induction regulator unit which is preferably mounted vertically in any desired position away from the motor. By rotating the rotor of the regulator the motor speed is varied.

The regulator is a double unit, consisting of two regulators with their secondary windings connected in series and the primary windings in parallel, an arrangement which gives a secondary voltage of constant phase and variable magnitude. At the same time, the torques of the two parts neutralise each other, and there is no resulting torque on the regulator shaft. A worm gear for holding the rotor is therefore unnecessary.

As the regulator hand wheel is moved away from the low-speed position, the regulator secondary voltage is gradually reduced and the motor speed rises. When the regulator voltage falls to zero, further movement of the regulator builds up the voltage in the opposite direction, thus causing the motor speed to rise above the synchronous value. The regulator acts as a controller with an infinite number of points and gives infinitely fine control of the speed over the range. A shunt characteristic is maintained at all speeds, and as the external losses are limited to those of the regulator, the overall efficiency is relatively high even at the lowest speed. The motor is most effectively utilised if the load is such that the torque remains constant as the speed varies, for under this condition the motor current is approximately the same at all

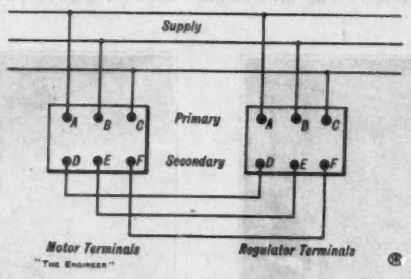


FIG. 3—EXTERNAL CONNECTIONS

speeds. Providing, however, that the motor and regulator are capable of giving the maximum torque required, the machine may be used for a constant horse-power or any other torque characteristic.

The external connections for the motor and regulator are given in Fig. 3, where it will be seen that the primary terminals of both motor and regulator are connected to the same three-phase supply, whilst the secondary terminals of the motor and regulator are connected together. To reverse the direction of rotation it is merely necessary to interchange two of the supply leads on both the motor and regulator, and to move the motor brush gear to the mark corresponding to the direction of rotation required. For starting the motor nothing beyond a simple three-phase switch is required, and although it is preferable, from the point of view of starting current, to switch the motor on with the regulator in the low-speed

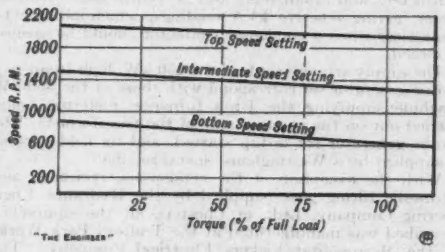


FIG. 4—TORQUE SPEED CURVES

position, it is permissible to start with the regulator in any position. In a typical case, with the regulator in the low-speed position, the motor will exert a starting torque of approximately 1¾ times full-load torque, with approximately 1¼ times full-load current. The speed may then be raised to that required by rotating the regulator hand wheel. If the switch is closed when the regulator is not in the low-speed position, both the starting torque and starting current will be increased and the running speed will, of course, also be higher.

Torque speed curves obtained from a motor rated at 3/1 h.p., 1900/630 r.p.m., are given in Fig. 4. These characteristics are of the shunt type, similar to those of a D.C. variable-speed shunt motor or of the alternative type of A.C. variable-speed commutator motor mentioned at the outset. Assuming the torque to remain constant, the drop in speed from no load to full load measured in actual revolutions per minute is approximately constant throughout the range, but increases near the bottom speed. The percentage drop in speed from no load to full load, therefore, increases considerably as the load is reduced, but the regulation is sufficiently close for most practical purposes, and operation is said to be much more stable than that of an induction motor with an external rotor resistance.

The motor is suitable for any small variable-speed drive where the supply is polyphase. Any speed range can be obtained, but the output must, of course, be reduced as the speed range is increased, particularly if continuous operation is required at low speeds.

HYDRO-ELECTRIC WORKS IN INDIA.

ACCOMPANIED by statements showing the financial results of irrigation, navigation, embankment, and drainage works, the Government of India's "Irrigation in India: Review for 1933–34," presents for every province a record of the character of the seasons, areas irrigated, works completed and in progress, and projects under consideration. The total area irrigated, 31,576,841 ac., was 1,345,373 more than the average of the preceding triennium, there having been increases 1,038,000 ac. in Sind and 347,387 ac. in the Punjab, and minor increases or decreases in other provinces.

In the United Provinces works in progress in the Ganges Canal hydro-electric scheme included:—(1) A 37-kV line, 39 miles long, and an 11-kV line of 3 miles; (2) a 37-kV line of 15 miles; (3) provision of rural lines, increase during the year from 83 to 138; (4) bringing the number of State tube wells to seventy-one in operation and forty-nine nearly ready. Excluding railways and State pumps, the connected industrial load increased from 7080 h.p. in March, 1933, to 9288 h.p. in March, 1934. The number of units sold increased from 13,494,000 to 16,483,000; the total assessment of revenue from Rs. 10·47 lakhs to Rs. 12·20 lakhs.

In the North-West Frontier Province, the hydro-electric scheme at Malakand, estimated to cost Rs. 42 lakhs, is designed to make use of the fall of the Upper Swat Canal, where it issues from the Malakand tunnel. The work was put in hand in 1934–35.

CONTRACTS AND ORDERS.

The Editor is always happy to print short announcements of contracts and orders in this column provided they are sent to him in time to have news value and that they are likely to interest readers.

MIRRLEES, BICKERTON AND DAY, Ltd., have recently received a number of contracts for Mirrlees-Diesel engines, including one for a three-cylinder engine for the Anglo-American Oil Company and one for a five-cylinder engine for the Raichur electrification scheme.

MERRYWEATHER AND SONS, Ltd., of Greenwich, have received from the Corporation of the City of Dublin an order for a motor turntable fire escape with an all-steel ladder to reach a height of 100ft. The ladder will be equipped with a water tower nozzle, life-saving apparatus, and telephone. The machine will also be fitted with a Merryweather "Hatfield" fire pump to deliver 275 gallons per minute. The equipment of the machine will also include a powerful searchlight for use on or away from the machine.

DAVEY, PAXMAN AND CO. (COLCHESTER), Ltd., have received an order for the main propelling machinery, consisting of a twin set of 40 h.p. Paxman-Ricardo Diesel engines, together with a 3 kW auxiliary lighting set, the power unit of which is a Paxman-Acro single-cylinder, heavy-oil engine, for installation in a new barge yacht which Firma G. de Vries Lentsch of Nieuwendam is building for Mr. Serocold. The yacht's pinnace will also be powered by a Paxman-Acro 5/7 h.p. crude oil engine with reversing propeller.

KOPPERS COKE OVEN COMPANY, Ltd., Sheffield, has received from John Bowes and Partners, Ltd., of Newcastle-on-Tyne, a contract for a new coke oven and by-product plant, to be erected on a site adjacent to Messrs. Bowes' private railway near Jarrow. The installation will carbonise 200,000 tons of coal per annum, and will produce special foundry coke of the Marley Hill quality. Arrangements have been made for the Newcastle and Gateshead Gas Company to take the surplus gas from the ovens. The coke oven installation will consist of thirty-three Koppers combination circulation ovens with cross-over regenerators constructed so as to permit of their being fired by low-grade gas if required in future. Complete coal-handling plant is included in the contract, with blending bunker and service bunker of 1000 tons capacity each. The by-product installation is to be of the latest Koppers type, including provision for the production of fine benzol and high-grade tar. It is expected that the installation will be in operation during the early part of 1937. Special arrangements have been made for as much work as possible in connection with this contract to be carried out in the North-East Coast area.

THE BIRTLEY COMPANY, Ltd., Birtley, has received from John Bowes and Partners a contract for a complete coal washery with coal-handling plant. The installation will comprise the latest type of Birtley washers, and will also include a battery of concentrating tables for washing fine sizes of coal. The Birtley-Henry system of water clarification will be adopted, in order to ensure that there shall be no dirty effluent from the plant.

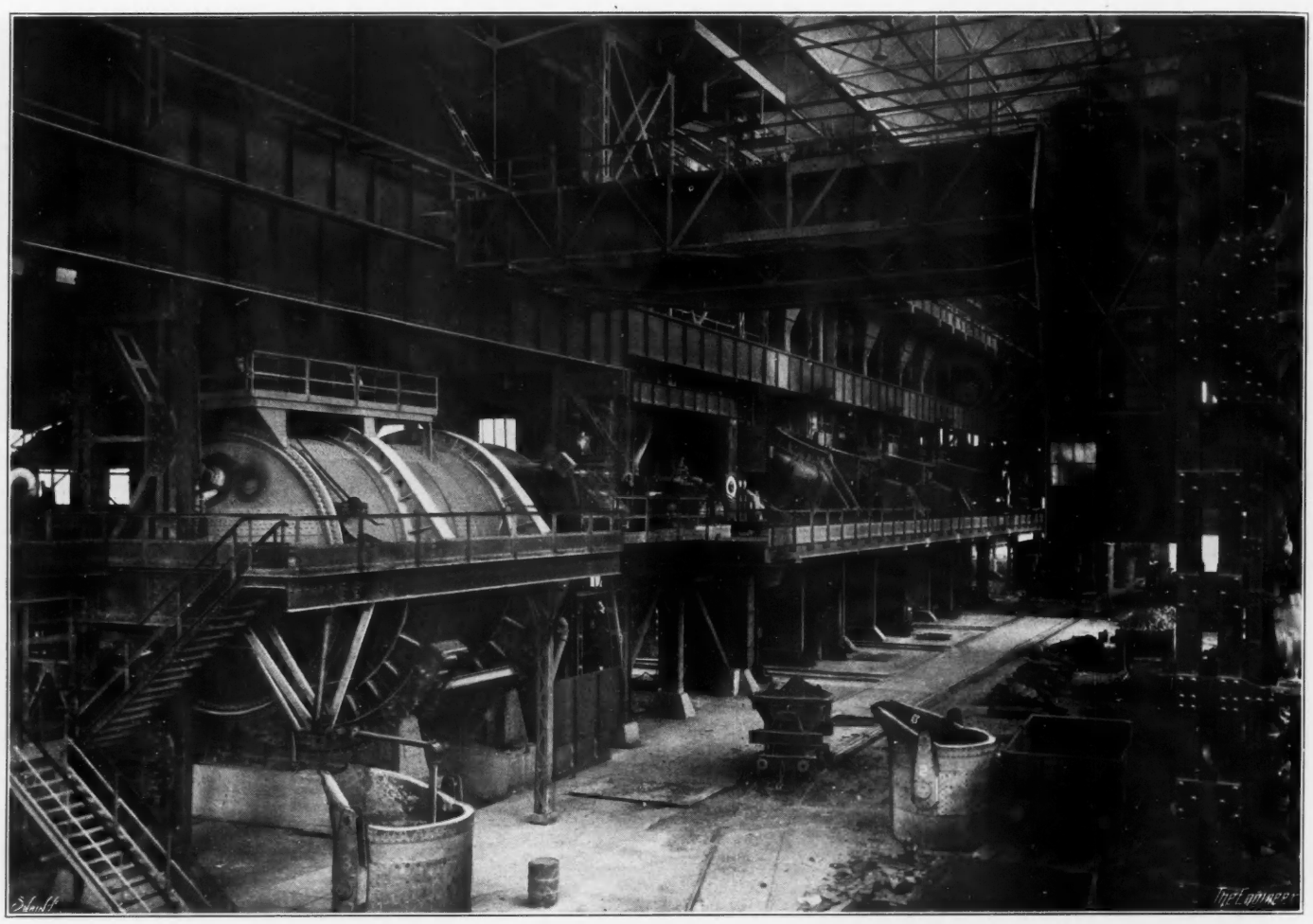
BRITISH TIMKIN, LTD.—On Wednesday, November 13th, we were present at a very pleasant informal dinner and cabaret performance which was arranged by British Timkin, Ltd., at the May Fair Hotel, in order to give British engineers an opportunity of meeting several of the leading engineers from French motor works. The guests numbered over one hundred, and in a few well-chosen words Mr. Michael Dewar, the chairman of British Timkin, Ltd., who presided, welcomed the French guests. A very enjoyable evening was spent and representatives of many British industries had an opportunity of meeting the staffs of British Timkin and its associated firms.

ROAD VEHICLE SPRINGS.—We have received an interesting brochure issued by the United Steel Companies, Ltd., dealing with the design, materials, and manufacture of road vehicle springs at the Stocksbridge Works of Samuel Fox and Co., Ltd. It contains nearly one hundred pages of data, illustrations, and drawings covering all aspects of spring design, location, fastening, manufacture, maintenance, and types, concluding with a technical supplement on load transference when braking, torque effect due to braking, pot-hole effect, mechanics of roll and tilting angle, and various formulæ relating to springs. The photographs used to illustrate the various sections are of a very high standard, and we are not surprised to learn that many of them were shown at the Summer Exhibition of the Professional Photographers' Association.

A MEMORANDUM PAD.—For the most part scarcely a day passes without the average engineer requiring to make a note to jog his memory or, quite as commonly, to explain some point by means of a sketch. For such purposes the "On-Every-Desk" memorandum pad, of which W. H. Colt (London), Ltd., Bush House, Strand, W.C.2, has sent us a sample, should prove very handy and convenient. It consists of a moulded bakelite base with five separate spring clips of the same material, each clip holding a small pad of scribbling paper. The clips are provided with celluloid inserts on which, if desired, catch lines or names may be written in order to associate the notes on any one pad with a particular subject or person. The bakelite base along its upper edge is moulded to receive pencils, &c., and is equipped with a universally jointed fountain pen holder. The pad is made in various forms, some of them plain and some of them embellished with oxidised metal or chromium plated fittings. In the most elaborate type a perpetual calendar and an eight-day clock are added to the pad. A special low-priced form made with four pads only and without the pencil rest or pen horn is also available. Although the pad as such can hardly be described as a production of engineering interest, it should, we think, be found of value in most engineers' offices.

THE CORBY IRON AND STEEL WOR OF

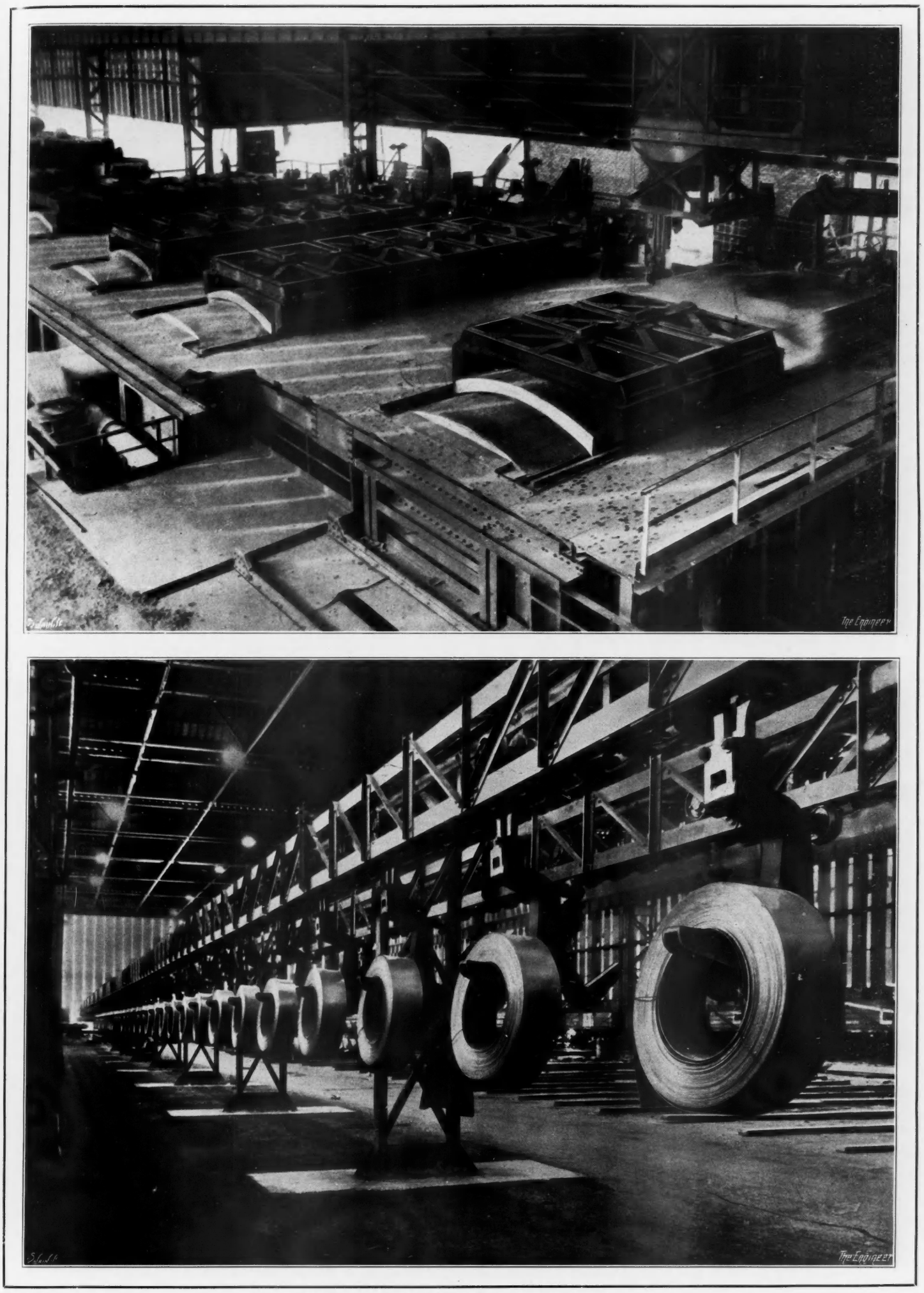
H. A. BRASSERT AND CO., LTD., ON, D



Above:—Basic Bessemer Plant with Hot Metal Mixer
Below:—Strip Mill with Reheating Furnaces and Coilers

OF STEWARTS AND LLOYDS, LTD.

LTD., ON, DESIGNERS AND ENGINEERS



ABOVE:—BLAST FURNACE GAS FIRED SOAKING PITS
BELOW:—FINISHING END OF STRIP MILL

Markets, Notes and News.

The prices quoted herein relate to bulk quantities. Unless otherwise specified home trade quotations are delivered f.o.t. Export quotations are f.o.b. steamer. A comprehensive list of the prices of materials mentioned below will be found on the next page.

British Imports of Iron and Steel.

THE Board of Trade Returns for October show an expansion in both the imports and exports of iron and steel when compared with September. The total imports last month reached 101,221 tons, against 89,309 tons in September, whilst the exports in October totalled 224,033 tons, compared with 187,153 tons in the previous month. Imports of pig iron were approximately the same as in September, the total being 5906 tons and 5337 tons respectively. Last month 3850 tons came from British India. Considerable interest attached to the imports of billets, blooms, and slabs, in view of the stringent conditions existing in the British market, but the total of 24,563 tons for October does not differ greatly from the September figure of 21,965 tons. There was, however, an increase in the imports from British countries, the October total being 8181 tons, against 6989 tons in September. Of foreign countries, France was the largest importer with 9518 tons, Belgium coming next with 4680 tons. Germany sent only 344 tons. There was a sharp reduction in the importations of sheet bars, which reached 4421 tons, against 7000 tons in September. In October, with the exception of 13 tons, all this material came from Belgium. The imports of girders, beams, joists and pillars increased last month to 10,970 tons, compared with 8675 tons in September. Last month Belgium sent 6436 tons and France 2629 tons. The imports of hoop and strip also showed a considerable increase in October to 5966 tons, against 3407 tons in the previous month. On the other hand, the imports of plates and sheets, not galvanised nor tinned, showed little difference and amounted to 4431 tons, against 4721 tons in September. The imports of tubes, however, were down to 1975 tons, compared with 2323 tons in September. No great change was shown in the imports of railway material, the figures for last month being 1322 tons, against 1144 tons in September. It is interesting to note that Belgium was again the largest supplier of all kinds of iron and steel materials, the total imported from that country being 42,930 tons. The next largest quantity, amounting to 17,190 tons, came from France, Luxemburg being third with 10,432 tons. The total of iron and steel imports from British countries reached 13,607 tons. Imports from Germany amounted to 6594 tons and from Sweden to 5748 tons.

Increasing Exports.

The best feature of the Returns is the increase in the exports, which were the highest since October, 1930, at 224,033 tons, the value being £3,509,836. Exports of pig iron during the month showed a substantial increase to 13,348 tons from 11,935 tons in September. The largest proportion of this consisted of foundry iron, of which 7401 tons was exported. The best customer was Belgium, who took 1583 tons, France coming next with 1197 tons. General descriptions of steel were exported to the total of 20,740 tons, compared with 17,668 tons in September. Of this, 4472 tons went to British India and 3471 tons to South Africa, Australia coming next with 1357 tons. The exports of girders, beams, and joists in October were approximately the same as in the previous month, the totals being 2359 tons and 2036 tons respectively; but 5509 tons of strip were exported in October, compared with 3823 tons in September. Exports of plates and sheets, not galvanised, under ¼in. thick, jumped from 11,814 tons in September to 16,800 tons last month. Of this Canada took the largest quantity, amounting to 1371 tons, British India being next with 1283 tons. Plates and sheets not under ¼in. thick were exported to the extent of 15,557 tons, compared with 13,775 tons in September. The Argentine was the largest buyer with 3560 tons, Canada coming second with 3048 tons, and British India third with 1273 tons. A sharp increase occurred in the exports of galvanised sheets from 17,432 tons in September to 22,130 tons last month, whilst there was a still more substantial rise in the exports of tin-plates from 23,713 tons to 33,683 tons in October. The exports of wrought tubes reached a total of 24,355 tons, against 21,685 tons in September, whilst there was little change in the exports of railway material, the total being 20,253 tons in October, compared with 20,441 tons in September. Of this quantity 9662 tons represented steel rails, 2489 tons sleepers and fish-plates, 2356 tons tires and axles, and 2198 tons wheels and axles complete. South Africa was the best customer in October with 33,534 tons, India coming next with 23,476 tons, and Australia next with 20,353 tons, whilst Canada took 19,230 tons. Of the foreign countries the largest tonnage of 10,263 tons went to the Argentine; Denmark took 8813 tons, Holland 6323 tons, whilst exports to Italy totalled 1180 tons.

The Pig Iron Market.

The recent advance in prices has had little influence upon the pig iron market. There may be a slight tendency on the part of consumers to restrict their purchases, but although users are well covered forward, they seem to be willing to take as much iron as they can get, and the feeling on the North-East Coast, at any rate, is that the position may yet become more stringent. Only limited quantities of iron are available for the market and the producers are not anxious to extend their forward commitments. Consumers have shown some anxiety regarding the position which may develop and many of them take the view that production should be expanded, as the number of furnaces in operation has not been increased for more than a year. The announcement that Dorman, Long intend to start an additional furnace on Cleveland iron should allay these fears. The difficulty of obtaining prompt supplies of Cleveland iron has led some local users to import parcels of Midland irons. In the Midlands the markets have not been quite so active as before the recent advance, but this may be due to further movements which have been made to adjust prices in certain "zones." The quotation for Scotland also was raised by 2s. 9d. to bring it into relationship with the Cleveland price. Heavy deliveries continue to be made against contracts which have been running for some time and also against those which were entered into just before the rise. The demand from the Midland light castings industry is on a good scale and appears to be growing. The heavy castings makers are also taking a large supply of iron, but most of them have covered themselves for some time to come. The volume of business in Lancashire has remained steady for some weeks, but the deliveries appear to be taxing the resources of some of the producers. A satisfactory feature of the Lancashire market is the somewhat improved position of the textile machinery trade, and although the industry is not working full time it is expanding output and taking substantial quantities of iron. In Scotland there is a good tone in the market, but new business has not been active since prices were raised. Deliveries are being well sustained, and specifications are reaching the producing works satisfactorily. Although the quotations for hematite have not been increased, the market seems to entertain little doubt that an upward movement will occur shortly. At present the margin between foundry and hematite iron is more than usual, whilst the demand is maintained at a high rate.

Scotland and the North.

The additional orders for ships which have reached the Scottish yards during the past fortnight, including the Admiralty orders, will ensure busy working conditions at the mills producing shipbuilding steel. The value of these contracts is estimated to amount to nearly five million pounds. The works lately were becoming anxious as orders for ship-plates, sections, &c., were being executed much more rapidly than new business was coming to hand; but the recent contracts have entirely altered the situation in this respect. The constructional engineers are engaged upon a number of important undertakings and are absorbing heavy quantities of steel. In addition, there is a large amount of prospective work in sight, which should ensure a good volume of new business towards the end of the year. The sheet works are busier than they have been for some time, and apart from a considerable improvement in the export demand for galvanised sheets, there has been a sharp expansion in the home market requirements of black sheets. To some extent this has been due to steady buying by the motor car manufacturers. Nearly all the re-rolling mills are well employed and some are working almost at capacity. Less competition is being experienced from English unassociated makers, and this has led to more orders being taken by the local works. Active conditions rule in the Lancashire steel market and all classes of consumers seem anxious to cover themselves against an advance in prices which they believe to be imminent. The recent increase of 7s. 6d. per ton in the price of No. 3 and No. 4 bars, making them £7 17s. 6d. and £8 17s. 6d. respectively, has naturally checked business to some extent, and for the better description of iron bars the demand has been only moderate. Deliveries of plates and sections to the constructional engineers have been on a heavy scale and many firms would be prepared to contract for supplies further ahead than the steel works care to commit themselves. Lately there has been a brisk trade passing in boiler plates, whilst the engineering industries also have recently taken good supplies of bright steel bars and special alloy steels.

The Midlands and South Wales.

The chief feature of the Midland steel market is the scarcity of billets of the kind principally required by consumers. Increased supplies over and above the Continental steel quota which have been arranged for by the Federation have not yet become available, and it is not at all certain how much will be distributed amongst Midland users. Consumers apparently have to make application to the Federation for the quantity they require. The price of these Continental billets to users will be £5 10s., or the same as the official quotation for British billets, although the supplies coming forward under the quota are sold by the Continent at £5 5s. to £5 9s. d/d, according to district. Nearly all the British manufacturers of billets are off the market, having booked as much forward business as they care to accept. In cases where business has been possible, the quotation has been £6. A good business is passing in joists and sections. Most of the constructional engineers seem to think that an advance in the home prices of structural steel will occur before the New Year, and, naturally enough, are doing their utmost to cover their prospective requirements. On the other hand, the manufacturers are showing less and less inclination to accept forward business. Some of them have contracts on their books for delivery up till next March, but it is difficult to place business for execution later than in the early part of next year. The mills producing small bars and strip are working at capacity, or as near to it as the difficulty of obtaining supplies of raw material will permit. The quotation for strip is unaltered at £9 7s., whilst the associated works' price for small bars is £8 12s., less a rebate of from 2s. 6d. to 5s. Outside works quote £8 for reinforced concrete quality, d/d Midlands, a figure which the associated makers frequently accept. Activity is growing in the South Wales markets, but the position of the tin-plate works remains unchanged as export orders are only accepted for shipment in January.

Current Business.

The War Office and the Air Ministry have placed orders with Crossley Motors, Ltd., for 350 six-wheeled chassis and 65 fire tenders, the total value of the contract being estimated at £300,000. The Albion Motor Works have purchased the Scotstoun Works of Halley Motors, Ltd., which went into liquidation last September. The Eagle Oil and Shipping Company, Ltd., has placed orders for four motor tankers. Two will be built by Lithgows, Ltd., and two by the Blythswood Shipbuilding Company, Ltd., Scotstoun, Glasgow. The vessels will each be 12,100 tons d.w., and the machinery will be supplied by John G. Kincaid and Co., Ltd., of Greenock. The formation of a company entitled Tunstall Steels, Ltd., is announced for the purpose of erecting works for the manufacture of steel required by Austin Motors, Ltd. A site of between 50 and 60 acres has been acquired at Alderley, Wolverhampton. Orders have been placed by the Rand Water Board for steel tubes to the value of £350,000 with the South Durham Steel and Iron Company, Ltd., Stewarts and Lloyds, Ltd., and the British Mannesmann Tube Co., Ltd. Babcock and Wilcox, Ltd., intend to extend their Dumbarton works. The additions will cover 19,000 square feet. A factory is to be built at Gateshead under the Government scheme to provide fully equipped industrial buildings to be let in sections in order to attract new trades to the distressed areas. Wynn Timmins and Co., Ltd., tool manufacturers, are adding new machine shops and making other additions to their plant at Birmingham. The Department of Overseas Trade announces that the following contracts are open for tender:—Siam, Royal State Railways: About 7,000 metric tons of steel rails and accessories (Bangkok, January 31st, 1936). Egypt, State Domains Administration: 19½ tons of wire, 2 mm. diameter, for power presses (Egypt, December 16th); Ministry of Public Works: electrically driven, 24in. centre lathe, and a 12in. slotting machine for Atf power station (Cairo, December 23rd); one Diesel-driven, 5 kW, d.c. generating set, complete with switchboard, &c., for the Nubian floating workshop (Cairo, December 18th).

Copper and Tin.

The electrolytic copper market seems to have settled down to a rather humdrum condition. Producers, however, are in a comfortable position and have to deliver good quantities of copper over the next six months. Consumers do not seem to be so well bought as was at one time believed, and this must be attributed largely to the difficulties experienced by European buyers in obtaining the necessary exchange to supply their needs. Heavy stocks of copper still exist in the hands of the producers, and at the end of October, in spite of a reduction during the month of 35,100 short tons, totalled 394,250 tons. The stocks in America were reduced by 14,700 tons, whilst in other countries the total fell by 20,401 tons. In October the American deliveries amounted to 59,081 tons, whilst for other countries they were estimated at 105,431 tons. According to these figures the deliveries last month were the highest since October, 1929. It may be owing to the decline in buying and to the not unnatural desire on the part of American producers to liquidate their stocks that they have lately sold a certain amount on the London Metal Exchange. This copper, of course, has gone into Metal Exchange warehouses and has helped to maintain the balance of stocks against some substantial withdrawals. On the London standard market rather brighter conditions have ruled of late and, following the election, a better tone developed. Speculators appear to have been attracted by the comparatively low price of the metal, and the bull account seems to be growing. . . . Artificial and unhealthy conditions have ruled in the tin market during the past week. After reaching a figure of £23 the backwardation receded to about £12, but it is still sufficiently heavy to act as a check upon business. Within a few days there will be heavy arrivals of Dutch and Banca tin, and the market is wondering how much of this will be used to relieve the situation. At the same time, it is pointed out that the increases in the tin quota have so far had little more than a sentimental influence upon the position. Some fair shipments of tin have been made to America, but actual business has been rather slow and many consumers seem to resent the high prices they are called upon to pay for brands of tin as a result of the inflated quotations for prompt metal.

Lead and Spelter.

Steady conditions have ruled in the lead market during the week and conditions generally have not altered. The demand from the consuming trades shows no signs of shrinking, whilst it is probable that the present deliveries of manufactured lead products have never been exceeded. For instance, the deliveries of lead pipes and sheets are at the rate of over 16,000 tons per month, which is a record for that branch of the industry. The demand can scarcely be expected to remain at this high level, but so long as the boom in house building continues there will, of course, be a call for these descriptions. It seems to be expected that the future requirements of the market will be met by the producers. No surplus of Empire lead is available after contract needs have been supplied, but arrivals of Mexican lead should soon make their appearance on the market. At first it was feared that most of this foreign metal would be bought by the Continent, but difficulties of finance, import quotas, and other restrictions seem likely to prevent the Continental users covering all their needs. Wherever possible, consumers are buying forward and apparently the difficulties of the situation are causing some uneasiness, as although talk is heard of a probable increase in lead production, there seems no sign of this movement maturing for some time. . . . The tone of the spelter market has shown a distinct improvement in the past few weeks, and whilst some of this may be attributed to sympathetic influences exercised by the lead market, there is no doubt that a belief in the statistical improvement of the metal has had something to do with the greater confidence shown by dealers. The industrial demand for spelter is on a good scale, although in some directions, noticeably in the case of the galvanising trade, buying has been rather disappointing.

Current Prices for Metals and Fuels.

Makers' official home trade prices per ton, delivered buyers' stations. Sections, joists and plates are subject to a rebate to home users purchasing only from associated British Steelmakers: joists, 22s. 6d.; plates and sections, 15s. Export orders of 250 tons and over may be subject to special quotations.

PIG IRON.

	Home.	Export.
	(*D/d Teesside Area*)	
N.E. Coast—	£ s. d.	£ s. d.
Hematite Mixed Nos.	3 10 6	3 2 0
No. 1	3 11 0	3 3 6
Cleveland—	(*D/d Teesside Area*)	
No. 1	3 12 6	3 4 0
No. 3 G.M.B.	3 10 0	3 1 6
No. 4 Forge	3 9 0	3 0 6
Basic (*Less 5/- rebate*)	3 10 0	—
Midlands—		
Staffs.—	(*Delivered to Black Country Station*)	
North Staffs. Foundry	3 15 0	—
„ „ Forge	3 10 0	—
Basic (*Less 5/- rebate*)	3 15 0	—
Northampton—		
Foundry No. 3	3 12 6	—
Forge	3 7 6	—
Derbyshire—		
No. 3 Foundry	3 15 0	—
Forge	3 10 0	—
Scotland—		
Hematite, f.o.t. furnaces	3 13 6	—
No. 1 Foundry, ditto	3 16 6	—
No. 3 Foundry, ditto	3 14 0	—
Basic, d/d (*Less 5/- rebate*)	3 10 0	—
N.W. Coast—		
Hematite Mixed Nos.	3 14 0 d/d Glasgow 3 18 6 „ Sheffield 4 4 6 „ Birmingham	

MANUFACTURED IRON.

	Home.	Export.
Lancs.—	£ s. d.	£ s. d.
Crown Bars	9 12 6	—
Best Bars	10 2 6	—
S. Yorks.—		
Crown Bars	9 12 6	—
Best Bars	10 2 6	—
Midlands—		
Crown Bars	9 15 0	—
Marked Bars (Staffs.)	12 0 0	—
No. 3 quality	7 17 6	—
No. 4 „	8 10 0	—
Scotland—		
Crown Bars	9 12 6	9 5 0
Best	10 2 6	9 15 0
N.E. Coast—		
Common Bars	9 12 6	8 15 0
Best Bars	10 2 6	9 15 0
Double Best Bars	10 12 6	10 0 0

STEEL.

	Home.	Export.
London and the South—	£ s. d.	£ s. d.
Angles	8 10 0	7 10 0
Tees	9 10 0	8 10 0
Joists	8 17 6	7 10 0
Channels	8 15 6	7 15 0
Rounds, 3in. and up	9 10 0	8 10 0
„ under 3in.	8 14 6	7 0 0
Flats, 5in. and under	8 14 6	7 0 0
Plates, ¾in. (basis)	9 0 0	7 15 0
„ ⅞in.	9 5 0	8 0 0
„ 1in.	9 10 0	8 5 0
„ 1⅛in.	9 15 0	8 10 0
„ 1¼in.	9 10 0	8 5 0
North-East Coast—	£ s. d.	£ s. d.
Angles	8 7 6	7 10 0
Tees	9 7 6	8 10 0
Joists	8 15 0	7 10 0
Channels	8 12 6	7 15 0
Rounds, 3in. and up	9 7 6	8 10 0
„ under 3in.	8 12 0	7 10 0
Plates, ¾in.	8 15 0	7 15 0
„ ⅞in.	9 0 0	8 0 0
„ 1in.	9 5 0	8 5 0
„ 1⅛in.	9 10 0	8 10 0
„ 1¼in.	9 5 0	8 5 0
Boiler Plates, ¾in.	9 5 0	—
Midlands, and Leeds and District—	£ s. d.	£ s. d.
Angles	8 7 6	7 10 0
Tees	9 7 6	8 10 0
Joists	8 15 0	7 10 0
Channels	8 12 6	7 15 0
Rounds, 3in. and up	9 7 6	8 10 0
„ under 3in.	8 12 0	7 10 0
Flats, 5in. and under	8 12 0	8 17 6
Plates, ¾in. (basis)	8 17 6	7 15 0
„ ⅞in.	9 2 6	8 0 0
„ 1in.	9 7 6	8 5 0
„ 1⅛in.	9 12 6	8 10 0
Boiler Plates, ¾in.	9 7 6	7 15 0

STEEL (*continued*).

	Home.	Export.
Glasgow and District—	£ s. d.	£ s. d.
Angles	8 7 6	7 10 0
Tees	9 7 6	8 10 0
Joists	8 15 0	7 10 0
Channels	8 12 6	7 15 0
Rounds, 3in. and up	9 7 6	8 10 0
„ under 3in.	8 12 0	7 10 0
Flats, 5in. and under	8 12 0	8 17 6
Plates, ¾in. (basis)	8 15 0	7 15 0
„ ⅞in.	9 0 0	8 0 0
„ 1in.	9 5 0	8 5 0
„ 1⅛in.	9 10 0	8 10 0
„ 1¼in.	9 5 0	8 5 0
Boiler Plates	9 5 0	—
South Wales Area—	£ s. d.	£ s. d.
Angles	8 7 6	7 10 0
Tees	9 7 6	8 10 0
Joists	8 15 0	7 10 0
Channels	8 12 6	7 15 0
Rounds, 3in. and up	9 7 6	8 10 0
„ under 3in.	8 12 0	7 10 0
Flats, 5in. and under	8 12 0	8 17 6
Plates, ¾in. (basis)	8 17 6	7 15 0
„ ⅞in.	9 2 6	8 0 0
„ 1in.	9 7 6	8 5 0
„ 1⅛in.	9 12 6	8 10 0
„ 1¼in.	9 10 0	8 5 0

Ireland—	Belfast.	Rest of Ireland.
	£ s. d.	£ s. d.
Angles	8 12 6	8 15 0
Tees	9 12 6	9 15 0
Joists	9 0 0	9 2 6
Channels	8 17 6	9 0 0
Rounds, 3in. and up	9 12 6	9 15 0
„ under 3in.	9 2 0	9 4 6
Plates, ¾in. (basis)	9 0 0	9 2 6
„ ⅞in.	9 5 0	9 7 6
„ 1in.	9 10 0	9 12 6
„ 1⅛in.	9 15 0	9 17 6
„ 1¼in.	9 12 6	9 15 0

OTHER STEEL MATERIALS.

	Home.	Export.
Sheets.	£ s. d.	£ s. d.
10-G to 13-G., f.o.r.	9 15 0	9 0 0
14-G. to 20-G., d/d	11 0 0	9 5 0
21-G. to 24-G., d/d	11 5 0	9 10 0
25-G. to 27-G., d/d	11 17 6	10 2 6

The above home trade prices are for 4-ton lots and over; 2-ton to 4-ton lots, 10s. per ton extra; and under 2-ton lots, 30s. per ton extra.

Galvanised Corrugated Sheets, Basis 24-G.

Home.	£ s. d.
4-ton lots and up	13 5 0
2-ton to 4-ton lots	13 12 6
Under 2 tons	15 5 0

Export: £12 15s. 0d., c.i.f. India.
„ £11 10s. 0d., f.o.b. other markets.
„ Scandinavian Markets free.

Tin-plates.
20 by 14 basis, f.o.b. Bristol Channel Ports, 18/9.
Tin-plate Bars, d/d South Wales Works, £5 10s. 0d.

Billets.	£ s. d.
Basic (0·33% to 0·41% C.)	6 12 6
„ Medium (0·42% to 0·60% C.)	7 2 6
„ Hard (0·61% to 0·85% C.)	7 12 6
„ „ (0·86% to 0·99% C.)	8 2 6
„ „ (1% C. and up)	8 12 6
Soft (up to 0·25% C.), 500 tons and up	5 10 0
100 to 250 tons	5 17 6
Rails, Heavy, 500-ton lots, f.o.t.	8 10 0
„ Light, f.o.t.	7 10 0

FERRO ALLOYS

	Per Ton.	Per Unit.
Tungsten Metal Powder	3/3 per lb.	
Ferro Tungsten	3/- per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 15 0	7/-
„ „ 6 p.c. to 8 p.c.	£21 0 0	7/-
„ „ 8 p.c. to 10 p.c.	£21 0 0	7/-
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£34 0 0	11/-
„ „ „ 1 p.c. carbon	£36 5 0	11/-
„ „ „ 0·50 p.c. carbon	£37 5 0	12/-
„ „ „ carbon free	9½d. per lb.	
Metallic Chromium	2/5 per lb.	
Ferro Manganese (loose) 76 p.c.	£10 15 0 home	
„ Silicon, 45 p.c. to 50 p.c.	£12 15 0 scale 5/- p.u.	
„ „ 75 p.c.	£17 17 6 scale 6/- p.u.	
„ Vanadium	12/8 per lb.	
„ Molybdenum	4/6 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£200 to £205	
Cobalt	5/6 per lb.	

NON-FERROUS METALS.

Official Prices, November 20th.

Copper—		
Cash	£35 6 3 to £35 7 6	
Three months	£35 13 9 to £35 15 0	
Electrolytic	£39 5 0 to £39 15 0	
Best Selected Ingots, d/d Birmingham	£39 10 0	
Sheets, Hot Rolled	£66 0 0	
	Home.	Export.
Tubes, Solid Drawn (basis)	10½d.	10½d.
„ Brazed (basis)	10½d.	10½d.
Brass—		
Ingots, 70/30, d/d Birmingham	£33 0 0 to £34 0 0	
	Home.	Export.
Tubes, Solid Drawn, 2/1 Alloy	9½d.	9½d.
„ Brazed	11½d.	11½d.
Tin—		
Cash	£224 0 0 to £224 10 0	
Three months	£212 5 0 to £212 15 0	
Lead: Cash and forward	£17 17 6	
Spelter:	£16 3 9 to £16 6 3	
Aluminium Ingots (British)	£100	

FUELS.

SCOTLAND.

Lanarkshire—	Export.
(f.o.b. Grangemouth)—Navigation Unscreened	14/- to 14/3
Hamilton Ell	16/6 to 17/-
Navigation Splints	17/6 to 18/-
Ayrshire—	
(f.o.b. Ports)—Steam	14/- to 14/6
Fifeshire—	
(f.o.b. Methil or Burntisland)—	
Prime Steam	15/- to 15/6
Unscreened Navigation	13/6 to 14/-
Lothians—	
(f.o.b. Leith)—Hartley Prime	15/- to 15/6
Secondary Steam	14/- to 14/6

ENGLAND.

Yorkshire, Manchester—	
B.S.Y. Hard Steams	18/6 to 21/6
Furnace Coke	14/6 to 17/6
Northumberland, Newcastle—	
Blyth Best	15/- to 15/6
„ Second	14/-
„ Best Small	10/6 to 11/-
Unscreened	12/6 to 13/6
Durham—	
Best Gas	14/8
Foundry Coke	19/- to 20/-

Sheffield—	Inland.	
Best Hand-picked Branch	24/- to 25/-	—
South Yorkshire Best	21/- to 23/-	—
South Yorkshire Seconds	18/- to 19/6	—
Rough Slacks	8/- to 9/-	—
Nutty Slacks	7/- to 8/6	—

SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Admiralty Large	19/6
Best Seconds	19/- to 19/4½
Best Dry Large	18/9 to 19/3
Ordinaries	18/3 to 18/6
Bunker Smalls	12/6 to 13/6
Cargo Smalls	11/6 to 12/6
Dry Nuts	22/- to 27/6
Foundry Coke	27/- to 40/-
Furnace Coke	19/- to 22/6
Patent Fuel	21/-
Swansea—	
Anthracite Coals:	
Best Large	36/- to 40/-
Machine-made Cobbles	41/- to 48/6
Nuts	40/- to 48/6
Beans	25/- to 30/-
Peas	19/- to 23/-
Rubbly Culm	11/- to 11/6
Steam Coals:	
Large Ordinary	18/- to 20/6

FUEL OIL.

Inland consumption; contracts in bulk.
Exclusive of Government tax of 1d. per gallon.

Ex Ocean Installation.	Per Gallon.
Furnace Oil (0·950 gravity)	3½d.
Diesel Oil	4d.

French Engineering Notes.

(From our own Correspondent in Paris.)

The Steel Comptoir.

THERE is now practical unanimity amongst French steel makers in accepting revised conditions for the renewal of the Comptoir Sidérurgique, and the only serious obstacle is the exacting demand of a Belgian firm which owns a steel works in the Nord, and having failed to reach a settlement at the last meeting, the Comptoir decided to continue negotiations and hold another meeting to-morrow, the 23rd. It is generally admitted that if these negotiations fall through the situation of the steel trade, both nationally and internationally, will be so serious that the Government will intervene to settle the difficulty by arbitration, or it may use the power conferred upon it by a recent decree to compel recalcitrant firms in an industry to submit to regulations imposed by a two-thirds majority of producers. Makers refusing to comply with the regulations may be obliged to close their works. There is also a possibility, which must be avoided at all costs, that the Government may be tempted to control the steel production in the national interest. The Comptoir cannot therefore afford to risk failure of private negotiation.

Import Restrictions.

The failure of the Government to include in its decrees any measure that will relieve foreign trade of the strangling burden of import quotas, tariffs, and other restrictions has awakened the maritime Chambers of Commerce and the ports to the necessity of action if seaborne traffic is to be saved from disaster. The Association des Grands Ports Français is preparing a plan for dealing with the whole fiscal policy relating to foreign trade which has suffered from "fragmentary measures" that take no account of the effect they are likely to produce on industries other than those they are intended to protect. Evidently, it says, nothing can be done except on a basis of reciprocity, but tariffs must be fixed at a moderate level and on a general plan, so that any situation may be dealt with automatically without improvising measures that invariably have a serious effect on the national economy. Incidentally, it may be added that the burden of official tariffs should not be increased by accessory taxes and charges which are prevalent in some foreign countries. The Union of Maritime Chambers of Commerce and French Ports has also sent a delegation to the Minister of Public Works to impress upon him the desperate plight of the ports as the result of the decline of shipping through import restrictions, particularly those imposed on coal. The Minister informed the delegation that the removal of such restrictions would be considered in relation to the interests of miners, coalowners, the ports and industry and commerce, which presumably means that there can be little hope of much being done to help shipping until it is possible to put in hand a general plan of foreign exchanges on a basis of reciprocity.

Shipping Costs.

An 8000-ton ship built for the Compagnie de Navigation Fraissenet for service between Marseilles and Corsica was recently launched from the yard at Port-de-Bouc of the Chantiers et Ateliers de Provence, and on that occasion Monsieur Jean Fraissenet spoke of the difficulties that beset shipowners as regarded construction and navigation costs. If it were not for the facilities offered by the State credit system, under the name of the Crédit Maritime, owners could not place orders in French yards, where the cost of building a ship like the one launched was, he said, nearly twice as much as in a foreign yard. That was only the beginning of the French shipowner's troubles, for legislation imposed obligations that increased his charges considerably. On an 8000-ton ship they must have a crew of forty-three, while a British ship of that tonnage needed to carry only thirty-nine, and on Italian and Danish ships the crews numbered thirty-five and thirty-one respectively. Another comparison made by Monsieur Fraissenet was that the monthly wages and cost of keep on a French ship of the type mentioned amounted to 67,000f., while on the British ship the total was 39,000f., on the Italian 37,000f., and on the Danish 29,000f. These figures were given to show the handicap imposed on French shipowners by a system of State control which is direct in some cases and indirect in others, whereby the influence of the seamen's union has to be taken into account in promoting legislation in favour of the men. Monsieur Fraissenet did not blame the men for endeavouring to improve their situation, but he deplored the consequences of heavy charges that prevented owners from competing successfully for international traffic. The tonnage of idle ships is increasing, and what the men on board ship have gained is more than lost to others by the heavy toll of unemployment in the shipping industry.

A Railway Model Exhibition.

The Association Française des Amis des Chemins de Fer is a comprehensive body comprising members interested in every phase of railway activity, and so far as concerns its membership of amateur and professional makers of models, it resembles the Society of Model and Experimental Engineers. The participation of this British society in an exhibition representing a century of progress in railway engineering may therefore be expected to stimulate interest in models apart from those produced by workers in locomotive shops that have been repeatedly shown at minor exhibitions arranged by the railway companies. On the present occasion the Exhibition, organised for the first time by the French association, is being held in a hall placed at its disposal by the P.L.M. Railway Company, and, in addition to the numerous British locomotive models, there are exhibits of models by all the French railway companies and from several foreign countries, amongst which Italy and Switzerland naturally show models of electric traction equipment. As a survey of a century's progress the Exhibition is incomplete, although in view of its popularity it may be the forerunner of other similar exhibitions, and will widen practical interest in the making of scale working models.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

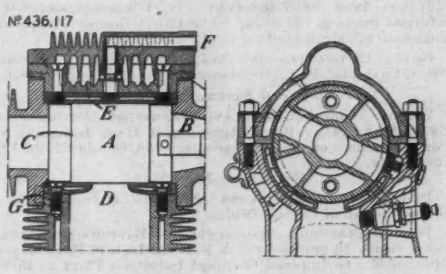
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C. 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

436,117. January 16th, 1935.—ENGINES WITH ROTARY VALVES, R. C. Cross, 33, Midford-road, Odd Down, Bath, Somerset.

This invention is concerned with the design of a rotary valve for internal combustion engines. The valve itself is shown at A, with an inlet at B, and exhaust at C. Communication is effected with the cylinder through the opening D. The valve

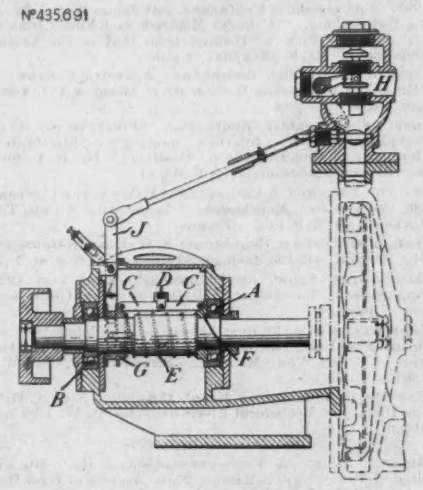


rotates in a liner E, which is of high-tensile steel, to enable it, by its springiness, to seal the opening D. It is lined with white metal and in order to maintain its temper it is made hollow, so that a coolant may be circulated round it. Ethelyne-glycol is suggested as a coolant. The coolant is introduced at F, and passes to the cylinder jacket at G.—*October 4th*, 1935.

TURBINE MACHINERY.

435,691. March 13th, 1935.—A SINGLE BEARING TURBINE, Holden and Brooke, Ltd., Sirius Works, West Gorton, Manchester, and D. G. McNair.

This invention is concerned with quite small steam turbines of the impulse type with an overhung impeller, and consequently known as "single bearing machines," although the illustration

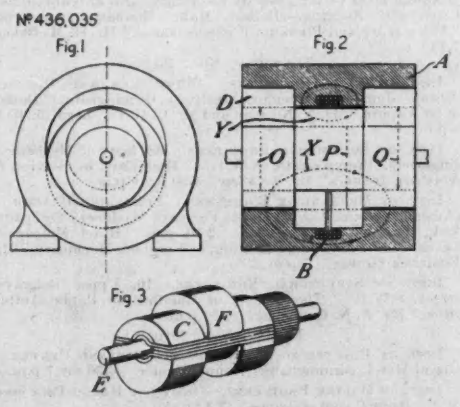


shows two ball bearings at A and B. Such turbines, the inventors say, are not generally governed as to speed. They, however, arrange a governor in the form of the toggle lever C C, with weights at D, working in opposition to a spring E. The collar F is fixed on the shaft, but that at G can slide. This collar controls the steam admission valve H through the linkage J.—*September 25th*, 1935.

DYNAMOS AND MOTORS.

436,035. August 30th, 1934.—ELECTRIC MOTORS, The British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C.2.

This alternating-current motor is designed to run at double the synchronous speed of the current supply. The stator A,

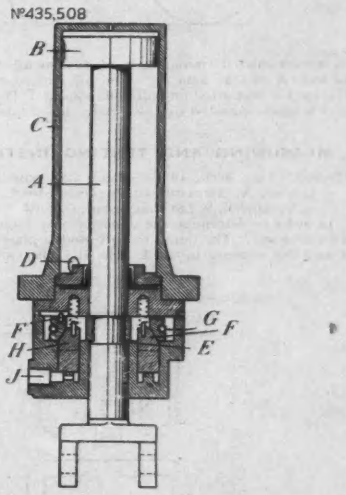


which has an energising winding B, is bored with three cavities, having opposite excentricities. The rotor also—see Fig. 3—has three separate excentric portions. Its maximum diameter is, however, such that it can rotate as one piece in the stator. The result is explained in the specification as follows:—In the position of the rotor shown in Figs. 1 and 2 it will be observed that each of the rotor sections approaches closely to that portion of the adjacent stator iron section which is nearest the central axis. Thus rotor section C approaches very close to the innermost portion of the stator formed by the cut-out section D at the point where this stator section approaches nearest the central axis and shaft E. A similar condition exists between the other end section and its adjacent stator portion. Likewise the central rotor section F approaches close to the central stator section at the point where it is nearest the central shaft, but these points of minimum air gap are 180 deg. apart in the central and end portions. In this position of the rotor there exists fairly low reluctance paths for any axial flux produced by winding B, these paths being indicated by the dotted lines X and Y in Fig. 2. If now the rotor be rotated 180 deg., the sections of the rotor will take the positions indicated in dotted lines O, P, and Q—Fig. 2—respectively, in which position each of the rotor sections will be in their maximum distance positions from their corresponding stator sections and the flux paths between stator and rotor will have a maximum reluctance. Thus it will be observed that the adjacent peripheral surfaces of stator and rotor are so shaped and disposed with respect to the axis of rotation that as the rotor is rotated it has minimum and maximum reluctance positions with respect to the stator once in each revolution, and the minimum reluctance position is 180 deg. from the maximum reluctance position. The magnetic material on both members is thus formed to provide a path for the axial flux that varies sinusoidally between a maximum and a minimum reluctance each revolution, and it will be evident that if the stator winding is energised by alternating current and the rotor is rotating at or near a speed which is synchronous therewith, there will be a synchronising torque which tends to bring the rotor in the position of minimum reluctance in synchronism with the half cycle flux pulsations. The motor may be conveniently regarded as a one-pole rotary reluctance motor. On a 60-cycle circuit, these flux pulsations will occur 120 times per second or 7200 times per minute, and consequently this motor will have a basic synchronous speed of 7200 r.p.m. on 60 cycles. The motor may also be energised by regularly re-occurring direct-current pulsations and the synchronous speed will be the same as the number of pulsations.—*October 3rd*, 1935.

ELECTRICAL APPLIANCES.

435,508. December 13th, 1934.—ELECTRO-MAGNETIC BRAKES, Knorr-Bremse Aktiengesellschaft, 9 to 17, Neue Bahnhofstrasse, Lichtenberg, Berlin, Germany.

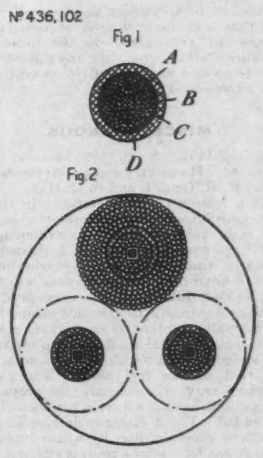
This is an arrangement for holding an electro-magnetic track brake clear of the rails when it is not in use. The brake magnet, not shown, is suspended from the rod A. This rod has a piston B that works in a cylinder C and can be pushed upward by compressed air admitted at D. The rod has a neck E round which



there are arranged segmental pieces F F pressed inwards by a garter spring G. Inside recesses in these pieces there is a conical member H which can be subjected to air pressure from below at J. When the brake is to be applied the air connections are automatically so arranged that pressure is released beneath the piston B and is applied beneath the member H, so that the locking rings are expanded and the brake rod is free to drop.—*September 23rd*, 1935.

436,102. May 17th, 1934.—ELECTRICAL HARPOON LINES, Siemens-Schuckertwerke Aktiengesellschaft, Berlin-Siemensstadt, Germany.

In catching whales it has recently become practice to electrocute the animal by means of a current conveyed by the harpoon line and returned to the whaling vessel through the



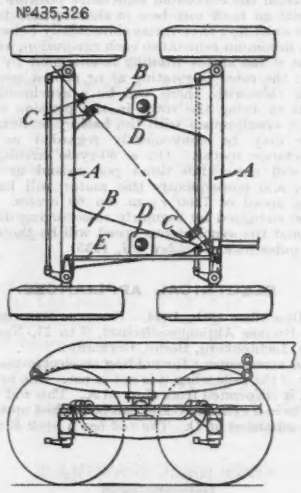
sea water. Trouble has, however, been experienced in the kinking of the line through the mutual disagreement of the hemp rope and the electrical conductor. The inventors consequently suggest a line for the purpose which they describe as follows:—The core of the conductor is formed by a rubber central element A, and is preferably covered by a knitted fibrous covering B around which the electric conductors C are placed,

and the whole covered by a rubber jacket D. The knitted fibrous covering B has the advantage that it is readily adaptable to the variations in length of the rubber core A, since the knitting machines provide loop stitches of the lengths and character necessary for the alteration in length of the covering and the covering can also yield upon the occurrence of any contraction. The electric conductors C, for example, copper wires, may be stranded in one layer or in several layers essentially with intermediate spaces. The spaces have for their object to impart to the wires or strands a certain freedom of movement with respect to each other and with respect to the rubber core or the rubber covering. The rubber core A may, furthermore, have a different cross section from the square cross section shown. Several such conductors may be stranded together with hemp ropes, as shown in Fig. 2.—*October 4th*, 1935.

MOTOR CARS AND ROAD TRAFFIC.

435,326. April 30th, 1934.—Four-wheel Steering, O. D. North, 76, Elm Park-mansions, Park-walk, Chelsea, London, S.W.10, P. G. Hugh, High Holborn House, 52 to 54, High Holborn, London, W.C.1, and Scammell Lorries, Ltd., High Holborn House.

In a bogie type road vehicle the steering wheels are mounted

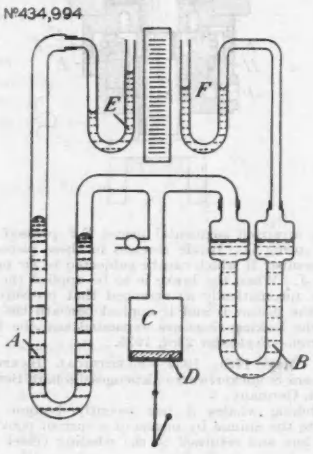


on an articulated frame made of two members, each having an axle A and an arm B, which are hinged together at C C. The load is supported on ball trunnions at D D and the steering gear is interconnected by the linkage E.—*September 19th*, 1935.

MEASURING AND TESTING INSTRUMENTS.

434,994. July 30th, 1934.—Measuring the Viscosity of a Liquid, A. Germant, 4B, Staverton-road, Oxford, and R. V. Southwell, 9, Lathbury-road, Oxford.

In order to determine the viscosity of a liquid it is compared with mercury. The liquid to be tested is placed in the U tube A and the mercury in the U tube B. The two tubes are con-



nected together and to a cylinder C, in which there works an air piston D that sets the columns of liquids in pulsation. These pulsations are transmitted to the measuring U tubes E and F, which are filled with benzine, and the relative amplitude of the pulsations gives a measure of the viscosity of the liquid being tested.—*September 12th*, 1935.

MISCELLANEOUS.

436,027. July 2nd, 1934.—Fuel Oils, The Gas Light and Coke Company, 84, Horseferry-road, Westminster, London, S.W.1, and R. H. Griffith and S. G. Hill.

This invention relates to improvements in fuel oils for use in compression ignition engines, especially coal tar oils or hydrocarbon oils of high cyclic structure, for example, light creosote oil with or without added gas oil. It is characteristic of such fuels, particularly those with a large content of aromatic hydrocarbons, to have high ignition points and to exhibit long delay periods, so that difficulties are experienced in using them as engine fuels. According to the invention, there is added to a fuel oil a small quantity of an organic compound which contains a halogen atom and a nitro-group on adjacent carbon atoms in the molecule, and which has an ignition point appreciably below that of the fuel alone. The substances used for the purpose may conveniently be prepared from unsaturated compounds having a double bond to which a molecule of halogen is added. The di-halogen derivative is then treated with a molecule of silver nitrate, by which replacement of one of the halogen atoms by a nitro-group is effected. The halogen-nitro compounds obtained in this manner are added to the fuel oil in small amounts of the order of ½ or 1 per cent. by weight. As an example, there is obtained from oleic acid by the process described above, 9-brom 10-nitro stearic acid and ½ per cent. of this by weight is added to fuel oil containing 80 per cent. by volume of light creosote oil and 20 per cent. by volume of gas oil. Other examples are given in the specification.—*October 3rd*, 1935.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

To-day.

Inst. of British Foundrymen: Junior Section, Lancashire Branch.—College of Technology, Manchester. "Practical Foundry Experiences," Mr. J. Sherwood. 7.30 p.m.

Inst. of Electrical Engineers: N.-Eastern Students.—Grand Assembly Rooms, Barras Bridge, Newcastle-upon-Tyne. Annual dance. 8 p.m.–1 a.m.

Inst. of Mechanical Engineers.—Storey's-gate, St. James's Park, S.W.1. "Utilisation of Creep Test Data in Engineering Design," Mr. R. W. Bailey. 6 p.m.

Inst. of Structural Engineers: Midland Counties Junior Members.—James Watt Memorial Inst., Birmingham. "Some Notes on Concrete," Mr. H. W. Coultas. 6.30 p.m.

Junior Inst. of Engineers.—39, Victoria-street, S.W.1. Informal meeting. Lecture, "The Correlation of Mining with Engineering," Mr. Alexander Reid. 7.30 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, Piccadilly, W.1. Discourse by Dr. John Read. 9 p.m.

To-day and Saturday, Nov. 23rd.

Public Works, Roads and Transport Congress and Exhibition, 1935.—Royal Agricultural Hall, Islington, N.1. For programme of meetings, see page 426, October 25th, 1935. Open daily.

Saturday, Nov. 23rd.

Inst. of Civil Engineers.—Students' afternoon visit to reconstruction of Chelsea Bridge.

Inst. of Electrical Engineers: N. Eastern Students.—Joint visit with graduates of N.E. Coast Inst. of Engineers and Shipbuilders to Imperial Chemical Industries Plant at Billingham. 3.30 p.m.

Monday, Nov. 25th.

Inst. of Electrical Engineers: N. Eastern Centre.—At Armstrong College, Newcastle-upon-Tyne. "Standardisation of Impulse-voltage Testing," Dr. T. E. Allebone and Mr. F. R. Perry. 7 p.m.

Inst. of Mechanical Engineers: Graduates.—Storey's-gate, S.W.1. "The Coal Dust Motor," Mr. C. F. Granthier. 6.15 for 6.45 p.m.

Royal Aeronautical Soc.—At Inst. of Electrical Engineers, Savoy-place, W.C.2. "Sound Proofing of Aircraft," Dr. S. J. Zand. 5.30 for 6 p.m.

Royal Soc. of Arts.—John-street, Adelphi, W.C.2. Cantor Lecture, "Geological Aspects of Underground Water Supplies," Dr. Bernard Smith. 8 p.m.

Tuesday, Nov. 26th.

Inst. of Automobile Engineers.—At James Watt Memorial Inst., Birmingham. "Cylinder Materials and Finish from the Users' Point of View as Distinct from that of the Castings Manufacturer," Mr. K. Brozyna. 8 p.m.

Inst. of Electrical Engineers: Scottish Centre.—At the Grosvenor Restaurant, Gordon-street, Glasgow, C.2. Annual dinner. 6.30 for 7 p.m.

Inst. of Electrical Engineers: Wireless Section.—Savoy-place, W.C.2. Informal meeting. "Standardising Performance of Broadcast Radio Receivers," Dr. R. L. Smith Rose will open discussion. 6 for 6.30 p.m.

Inst. of Locomotive Engineers: Manchester Centre.—At 36, George-street, Manchester. "Locomotive Wheels, Tires, and Axles," Mr. E. S. Cox. 7 p.m.

Inst. of Structural Engineers: S. Wales and Monmouthshire Branch.—Baltic Lounge, Swansea. Meeting at 7 p.m.

Manchester Assoc. of Engineers.—Head Post Office, Spring-gardens, Manchester. Display of Post Office sound films. 7 p.m.

Sheffield Metallurgical Assoc.—In collaboration with Iron and Steel Inst., 198, West-street, Sheffield, 1. "The Penetration of Molten White Metals into Stressed Steel," Mr. W. E. Goodrich. 7.30 p.m.

University of London: King's College.—Strand, W.C.2. "The History of Mechanical Invention," Mr. H. W. Dickinson. 5.30 p.m.

Wednesday, Nov. 27th.

Belfast Assoc. of Engineers.—Central Hall, Municipal College of Technology, Belfast. "Some Aspects of Feed Water Treatment," Mr. J. S. Merry. 7 p.m.

Inst. of Automobile Engineers.—At Engineers' Club, Manchester. "Cylinder Materials and Finish from the Users' Point of View as Distinct from that of the Castings Manufacturer," Mr. K. Brozyna. 7 p.m.

Inst. of British Foundrymen: Preston Section.—Technical College, Corporation-street, Preston. "Insight to Modern Sand Testing," Mr. W. B. Knagg. 7.30 p.m.

Inst. of Civil Engineers: Yorkshire Assoc.—Grand Hotel, Sheffield. "The Manufacture and Testing of Rolling Stock Equipment," Mr. A. Witheford. 7.30 p.m.

Inst. of Electrical Engineers: London Students' Section.—Savoy-place, W.C.2. "Single Line Railway Signalling," Mr. H. Birchenough. 6.30 p.m.

Inst. of Metals: London Local Section.—Thames House, S.W.1. Supper-dance. 7.30 p.m.

North-East Coast Inst. of Engineers and Shipbuilders: Graduate Section.—Bolbec Hall, Newcastle-upon-Tyne. "Piece Work and Premium Bonus Schemes," Mr. G. M. Baker. 7.15 p.m.

Thursday, Nov. 28th.

Inst. of Civil Engineers: Birmingham and District Assoc.—James Watt Memorial Institute, Birmingham. "Design of an Airport," Mr. N. Norman and Mr. G. R. Dawbarn. 5.30 for 6 p.m.

Inst. of Locomotive Engineers.—At Inst. of Mechanical Engineers, Storey's-gate, S.W.1. "Rail Cars in Service in Northern Ireland," Mr. A. Allen. 5.30 for 6 p.m.

Inst. of Mechanical Engineers: Yorkshire Branch.—(Amended Notice.) Visit to the Forgrove Machinery Company, Ltd., Dewsbury-road, Leeds. 2.30 p.m. Hotel Metropole, Leeds. Tea. 5.30 p.m. Meeting, "Wrapping Machinery," Mr. Frederick Grover. 7 p.m.

Inst. of Structural Engineers.—10, Upper Belgrave-street, S.W.1. "The Control of Building by Public Authorities," Mr. A. N. C. Shelley. 6.30 p.m.

Friday, Nov. 29th.

Inst. of Electrical Engineers: S. Midland Centre.—Grand Hotel, Birmingham. Annual dinner. 6.30 for 7 p.m.

Inst. of Marine Engineers.—Grosvenor House, Park-lane, W.1. Annual conversazione. 7.30 p.m.

Inst. of Mechanical Engineers.—Storey's-gate, St. James's Park, S.W.1. Thomas Hawksley Lecture. "Muscles and Nerves: The Maintenance of Posture, the Development of Power, and the Transmission of Messages in the Body," Professor A. V. Hill. 6 p.m.

Inst. of Production Engineers.—Holborn Restaurant, London, W.C.1. Annual dinner.

Junior Inst. of Engineers.—39, Victoria-street, S.W.1. Informal meeting. Lecture, "Application of Statistics to Industrial Problems," Mr. B. P. Dudding. 7.30 p.m.

North-East Coast Inst. of Engineers.—Bolbec Hall, Newcastle-upon-Tyne. "The Theory of the Bulbous Bow and its Practical Application," Mr. W. C. S. Wigley. 6 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, Piccadilly, W.1. Discourse, "The Size and Age of the Universe," Sir James Jeans. 9 p.m.

Saturday, Nov. 30th.

Inst. of Structural Engineers: Midland Counties Branch.—Midland Hotel, Birmingham. Annual dinner. 6.45 p.m.

Monday, Dec. 2nd.

Royal Soc. of Arts.—John-street, Adelphi, W.C.2. Cantor Lecture, "Geological Aspects of Underground Water Supplies," Dr. Bernard Smith. 8 p.m.

Soc. of Engineers.—At Geological Soc., Burlington House, W.1. "Light Two-stroke Cycle Engines," Mr. G. P. Devaney. 5.30 for 6 p.m.

Tuesday, Dec. 3rd.

Inst. of Engineers and Shipbuilders in Scotland.—39, Elmbank-crescent, Glasgow, C.2. "Electrification of Glasgow District Subway," Mr. W. R. Bruce. 7.30 p.m.

Wednesday, Dec. 4th.

Royal Soc. of Arts.—John-street, Adelphi, W.C.2. "Travel in the Stratosphere," Professor G. T. R. Hill. 8 p.m.

Thursday, Dec. 5th.

Inst. of Structural Engineers: Yorkshire Branch.—Hotel Metropole, Leeds. Film record of a Welded Building, with a running commentary by Mr. P. L. Roberts. 7 p.m.

Friday, Dec. 6th.

Inst. of Mechanical Engineers.—Storey's-gate, St. James's Park, S.W.1. Informal meeting. 7 p.m.

Junior Inst. of Engineers.—39, Victoria-street, S.W.1. Informal meeting, "Iron: Past and Present, Manufacture and Uses," Mr. R. Lowe. 7.30 p.m.

Railway Club.—At Royal Scottish Corporation Hall, Fetter-lane, E.C.4. "How the L.B. and S.C. Railway Kept the Eastbourne Traffic," Rev. R. B. Fellows. 7.30 p.m.

Tuesday, Dec. 10th.

Inst. of Automobile Engineers.—At Geisha Café, Hertford-street, Coventry. "Small Car Engines," Mr. L. J. Shorter. 7.30 p.m.

Wednesday, Dec. 11th.

Inst. of Engineers-in-Charge.—St. Bride Inst., Bride-lane, E.C.4. Three short papers, "Central Heating and Hot Water Supply," by Gas, Electricity, Coal and Coke respectively, Messrs. R. J. Willsmer, A. Klansner, and H. F. Philliston. 6.30 for 7.30 p.m.

Thursday, Dec. 12th.

Inst. of Structural Engineers.—10, Upper Belgrave-street, S.W.1. "Some Bridge and Foundation Problems," Mr. Leslie Turner. 6.30 p.m.

Friday, Dec. 13th.

Inst. of Mechanical Engineers.—Storey's-gate, St. James's Park, S.W.1. "Damping Influences in Torsional Oscillation," Dr. J. F. Shannon. 6 p.m.

Junior Inst. of Engineers.—At Royal Soc. of Arts, John-street, W.C.2. Presidential address, "Coal, Power and Smoke," Sir Frank E. Smith. 7.30 p.m.

Saturday, Dec. 14th.

Manchester Assoc. of Engineers.—At College of Technology, Manchester. Conversazione and dance. 6.45 p.m. to 11.30 p.m.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

Babcock and Wilcox, Ltd., inform us that Mr. W. Baylis has retired and that Mr. F. W. Woodfield has been appointed manager of their Manchester office in his stead.

H. R. Marsden, Ltd., Soho Foundry, Meadow-road, Leeds (in voluntary liquidation), advises us that the business has now been sold, and that a new company is being formed to carry it on.

Murray and Paterson, Ltd., Coatbridge, inform us that at a recent meeting of the directors Mr. J. G. McGregor, B.A., B.Sc., A.M.I. Mech. E., was elected to the directorate and to the position of assistant managing director.

Lorant and Co., Ltd., 48, Croydon-road, London, S.E.20, advise us that as the sole agencies held by Lorance Ltd., now in voluntary liquidation, have been transferred to them, they can supply all the special tools and machines previously supplied by that company.

Ashworth Son and Co., Ltd., Midland Ironworks, Dewsbury, announce that their business has been amalgamated with the weighing machine business of Charles Ross, Ltd., Sheffield, and that the manufacturing part of the combined business will be carried on at the Dewsbury works. In future the company will trade under the name of Ashworth, Ross and Co., Ltd.

Ruston and Hornsby, Ltd., and R. A. Lister and Co., Ltd., announce that the rationalisation agreement entered into between them in 1930 is being terminated by mutual consent on March 31st next. The reason for the termination, we are advised, is a gradual change in basic factors affecting the respective businesses which could not have been envisaged at the time the agreement was entered into. It has therefore been felt by the boards of both companies that their individual and joint interests will be best served by the termination.

Association of Consulting Engineers.—What was referred to as the twenty-fifth anniversary dinner, was held, as usual, at St. Stephen's Club, Westminster, on November 15th, when about 200 members of the Association of Consulting Engineers and their guests were entertained, under the chairmanship of Sir Cyril Kirkpatrick. The guest of the evening, Lord Lloyd of Dolobran, in proposing "Engineering and Our Empire," referred to the works and ways of British engineers the world over and more particularly to those parts of the Empire in India and Egypt, with which he was particularly associated. He mentioned particularly how great works were executed without ostentation and how vast schemes had been carried through without so much as a reference to them in the Press. The toast was ably acknowledged by the President of the Institution of Civil Engineers, Mr. J. D. Watson. "Our Legal Friends" was amusingly given and responded to by Mr. S. P. Lewis and Mr. Wrottesley, K.C., and Mr. Arthur Lees. Sir Clement Hindley, in proposing "The Association," made much reference to the ethics of advertising as applied to consulting engineers, and also to the latest move in this direction by the Institution of Civil Engineers. Sir Cyril Kirkpatrick wound up a very enjoyable evening with a few sentences, which upheld the best traditions of after-dinner speaking.